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PHYSICS ABSTRACTS

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SCIENCE ABSTRACTS—SECTION A

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ABSTRACTS 674-962

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CONTENTS

ABSTRACTS 674–962

		Page
51	Mathematics	77
52	Astronomy	77
53	Physics	79
530	General principles	79
531	Mechanics	79
532	Liquids	80
532.5	Hydrodynamics	80
532.7	Solutions	80
533	Gases	81
534	Sound. Vibrations	81
535	Light	82
535.215	Photo-electricity	82
535.24	Photometry	83
535.3	Refraction.	83
535.33	Spectra	83
535.34	Absorption	84
535.37	Luminescence	85
535.4	Interference. Diffraction	85
535.6	Colour	85
535.7	Vision	85
535.8	Instruments	86
536	Heat	86
536.2	Conduction. Convection	86
536.42	Change of state	86
536.44	Critical points	87
536.5	Thermometry	87
536.6	Calorimetry. Sp. heat	87
536.7	Thermodynamics	87
537	Electricity	87
537.531	X-rays	88
537.533	Electron scattering	91
537.591	Cosmic rays	91
538	Magnetism. Electromagnetism	92
539	Molecular and atomic physics	94
539.16	Radioactivity	95
539.18	Nuclear rays	96
539.21	Microstructure	97
539.3	Elasticity	97
541	Physical chemistry	99
541.12	Equilibria. Kinetics	99
541.13	Electrochemistry	99
541.14	Photochemistry	100
541.18	Colloids	100
541.183	Adsorption	101
541.2	Atom. and mol. wt.	101
541.5	Valency	101
541.6	Chemical structure	101
541.8	Solutions	101
542	Practical chemistry	101
548	Crystallography	102
55	Geophysics	102
550.34	Seismology	103
550.36	Terrestrial thermodynamics	105
550.38	Terrestrial magnetism	105
551	Physical geography	105
551.5	Meteorology	106

The language of an original article is indicated after the decimal number, unless the article is in English, thus: = 3 German, = 4 French, = 5 Italian, = 6 Spanish, = 82 Russian, = 956 Japanese.

MATHEMATICS

674 512.8

The generation of inseparable fields. SCHMIDT, F. K., AND MACLANE, S. *Proc. Nat. Acad. Sci., Wash.*, 27, *pp.* 583–587, *Dec.*, 1941.

675 512.831 : 621.3.012.8

A matrix theorem. PEN TUNG SAH, A. *Elect. Engng, N.Y.*, 60, *pp.* 615–616, *Dec.*, 1941.

676 512.975 : 515.91

Intuitive and descriptive geometry of function space: Metric properties and transformation of co-ordinates. Geometric configurations. Tensors and by-vectors. LONGTIN, B., AND RANDALL, M. *J. Wash. Acad. Sci.*, 31, *pp.* 441–484, *Nov.* 15, *and pp.* 485–494, *Dec.* 15, 1941.—[See Abstr. 3 (1942)].

677 517.433 : 531.391.5

Control problems. MINORSKY, N. *J. Franklin Inst.*, 232, *pp.* 451–487, *Nov., and pp.* 519–551, *Dec.*, 1941.—Classification of the different control systems dealt with is based on the analytical features of the mathematical operators characterizing the control process rather than on material details of corresponding control systems. This form of classification correlates more definitely the properties of different control systems with those of the differential equations governing the controlled process. The first 3 sections of the paper deal with linear control problems, to which class belong practically all existing control systems. A review is also given of non-linear control problems. The intrinsic difficulties of non-linear control have retarded its introduction, but various possible applications are suggested where the advantages of such methods outweigh the difficulties encountered in their use. A. W.

See Abstr. 721 517.433 : 550.341 : 534.213

See Abstr. 727 517.433 : 550.341 : 534.811

678 517.933

Concerning the differential equations of some boundary-layer problems. WEYL, H. *Proc. Nat. Acad. Sci., Wash.*, 27, *pp.* 578–583, *Dec.*, 1941.

679 518.3 : 532.13

Viscosity nomographs for organic liquids. DAVIS, D. S. *Industr. Engng Chem.*, 33, *pp.* 1537–1539, *Dec.*, 1941.

680 519.271.3

On the precision of estimates from systematic *v.* random samples. OSBORNE, J. G. *Science*, 94, *pp.* 584–585, *Dec.* 19, 1941.

681 519.272

Some properties of a composite, bivariate distribution in which the means of the component normal distributions are linearly related. CHARNLEY, F. *Canad. J. Res. A*, 19, *pp.* 139–151, *Dec.*, 1941.—Equations relating the statistics of a linear, composite, bivariate, normal distribution with those of the component distributions are derived for 2 types of data: (1) for the special (ideal) case when the means represented by the samples correspond to the points of the linear continuum, and the proportions of the component populations remain constant, and (2) for the practical case when the point set, representing the means of the component distributions from which the samples have been drawn, differs from the linear continuum, and the proportions or densities of the component populations vary along the line of relation. The results show that, if the component populations are normal and the variances and correlation coeff. in the component populations are const., we can calculate at most only 2 of the parameters of the component populations from the composite data. We can, however, always calculate the values of the slope of the line of relation and vertical variance around this line, irrespective of the functional forms of the component populations, providing the means of the latter are collinear and provided also that the data can be separated into sub-groups corresponding to single populations.

682 519.272 : 621.39

A simple introduction to the use of statistics in telecommunications engineering. IV. Correlation and regression. DOUST, J. F., AND JOSEPHS, H. J. *P.O. Elect. Engrs' J.*, 34, *pp.* 173–183, *Jan.*, 1942.—[See Abstr. 9 (1942)].—This article discusses the analysis of bivariate distributions and shows how to test the significance of correlation coefficients obtained from small samples.

683 519.4

Maximal invariant proper subgroups of a finite group. MILLER, G. A. *Proc. Nat. Acad. Sci., Wash.*, 27, *pp.* 587–590, *Dec.*, 1941.

ASTRONOMY

684 522.91 : 523.31

The solar parallax and the mass of the moon from observations of Eros at the opposition of 1931. JONES, H. SPENCER. *Mem. Roy. Astr. Soc.*, 66, 2, [66 *pp.*], 1941. See also Mon. Not. Roy. Astr. Soc., 101, 8, pp. 356–366, 1941.—As a result of the measurement and reduction of 2 847 photographic plates secured at 24 observatories during the 1931 opposition of Eros, the solar parallax is found to be $8''{\cdot}790 \pm 0''{\cdot}001$. The results are internally consistent, whether they are derived from photographic refractor plates or from visual refractors taken through yellow screens. The results depending on the primary reference stars agree with those

depending on the secondary reference stars, and the results from R.A. and dec. separately are in agreement. The effects of differential atmospheric dispersion are discussed and are shown to be quasi-accidental; any systematic effect is probably very small. New values are also derived for the const. of the lunar equation and the mass of the moon. A general adjustment of fundamental astronomical constants suggests that the const. of nutation is not so well determined as is usually supposed. A. HU.

685 523.1 = 3

Cosmic abundance of the light elements. UNSÖLD, A. *Z. techn. Phys.*, 21, 12, *pp.* 301–303, 1940.—[Abstr. 2020 (1941)].

686 523.165 = 3

Temperature effect of cosmic rays. KOLHÖRSTER, W. *Z. techn. Phys.*, 21, 12, *pp.* 284–289, 1940.—[Abstr. 2068 (1941)].

687 523.165 = 3

The period of ½ solar day of the cosmic rays at the equator. RAU, W. *Z. Phys.*, 116, 1–2, *pp.* 105–114, 1940.—The period of ½ solar day observed at the Lake of Constance for the intensity of the hard component of the cosmic rays is clearly recognized in observations on the mountains of Peru near the Equator. The amplitude is about $\pm 0{\cdot}8\%$. The phase agrees with the phase observed in the Lake of Constance at 40 m. depth. O. O.

See Abstr. 684 523.31

688 523.34

Depression of lunar craters. MCINTOSH, R. A. *J. Roy. Astr. Soc. Can.*, 35, *pp.* 361–365, *Nov.*, 1941.—From measures of the depths of 52 craters (with central peaks) and 47 walled plains (without central peaks), histograms are drawn showing the frequency distribution of depths. The walled plains are on the average shallower than the craters, possibly because of partial filling subsequent to their creation. Strong correlation ($r = 0{\cdot}76$) is found between depression of a crater floor and diameter of the crater, weaker correlation ($r = 0{\cdot}36$) between the same quantities in walled plains. The data favour the meteoritic theory of origin rather than the volcanic. A. HU.

689 523.74

On the radial limitation of the solar magnetic field. MAJUMDAR, B. *Indian J. Phys.*, 15, *pp.* 131–143, *April*, 1941.—The drift-current, dynamo and diamagnetic theories of the radial limitation of the general magnetic field of the sun are discussed. A summary is given of the mathematical results, obtained in a previous paper, for the behaviour of an electron in electric, magnetic and gravitational fields. The results are applied to analyse the drift-current and dynamo theories of the radial limitation in a solar atmosphere of isothermal equilibrium under gravity. The diamagnetic theory of this limitation has been developed, the diamagnetism being now induced by the quantization in the motion of the electrons in the magnetic field. It is concluded that according to none of these theories can the magnetic field be radially limited to the extent as found from the observations of Hale in 1913. Similar conclusions seem to follow from a study of the polarization of non-uniform rotation of the sun in its magnetic field.

690 523.74

Note on the distribution of faculae and sunspots. ARCHENHOLD, G. H. A. *Observatory*, 64, *pp.* 165–168, *Dec.*, 1941.—From Greenwich data it is confirmed that during some periods areas of faculae on the E. hemisphere of the sun are not the same as on the W. The large eastern excess found by Maunder in the period 1896–1915 was transformed to a small western excess in the period 1916–1936. The areas of spot groups give an eastern excess in the cycle 1889–1901 but western excesses for the following 3 cycles. The numbers of spot groups, however, show a persistent eastern excess throughout, whether the 2 halves or only the limb zones are compared. It is concluded that the data show no convincing evidence for an Earth effect. A. HU.

691 523.74 : 581.14

Sunspots and tree rings. MOSELEY, E. L. *J. Roy. Astr. Soc. Can.*, 35, *pp.* 376–392, *Nov.*, 1941.—A tree-ring number for a given area and a given year is defined as the percentage of trees studied in that area which in that year made a growth ring clearly wider than the average. Negative numbers represent years with rings predominantly narrower than average. Numbers are given for 4 areas in the U.S. for the period 1698–1937 and are correlated with sunspot numbers and (for the latter part of the period) with precipitation. Evidence is presented for the existence of a cycle of about 90 years in sunspot numbers and in tree-ring numbers. A. HU.

692 523.75

The motion of gases in the sun's atmosphere. III. On the stratification of the solar envelope. DAS, A. K. *Indian J. Phys.*, 15, *pp.* 79–93, *April*, 1941.—The relative merits of existing theories of the solar chromosphere and their inadequacy to explain some of the salient facts of observation are discussed and the necessity for analysing the phenomena of the solar envelope from a different angle is emphasized. The dynamics of the motion of gases in the sun's atmosphere developed in an earlier paper [Abstr. 2542 (1941)] is used to evolve a mode of formation and maintenance of the different layers of the solar envelope. It is shown that this new process admits of quantitative treatment and yields heights of the reversing layer, the chromosphere and the quiescent prominences, in good agreement with observation. The fact that all gases reach practically the same height in prominences, the increase of rotation speed with altitude in prominences, the fibrous structure of

the chromosphere and several other facts of observation, follow naturally from this process. The picture is, however, admittedly incomplete, but its success so far indicates that the dynamical principle on which it is based probably plays an important part in the phenomena of the solar envelope.

693 523.75

Comparison of H and He radiation in solar prominences. THACKERAY, A. D. *Observatory*, 64, *pp.* 169–174, *Dec.*, 1941.—Study of any differences of form or intensity exhibited by the same prominence in the light of different elements is of importance in assessing the role of radiation pressure in supporting the solar chromosphere. Intensity differences are, however, affected by photographic contrast, by curve-of-growth effects and by self-reversal. The author draws attention to the value of visual observations of prominences in He light (D_3) with the spectrohelioscope, as a means of attacking the problem. The preliminary results of a series of such observations are discussed, and it is suggested that a classification of prominences according to their He : H intensity ratio would be useful. A. HU.

See Abstr. 738 523.81 : 535.247

PHYSICS

GENERAL PRINCIPLES

694 530.14 = 4

The meaning of proper time in wave mechanics. STUECKELBERG, E. C. G. *Helv. Phys. Acta*, 14, 5–6, *pp.* 322–323, 1941.

695 530.145 = 4

Quantum interpretation of certain results of classical mechanics. DATZEFF, A. *J. Phys., U.S.S.R.*, 4, 3, *pp.* 269–276, 1941.—Approx. formulae are derived for the motion of 3 particles, of which 2 carry equal and opposite charges, whereas the third is neutral. Certain formal similarities between these results and the Bohr model of the atom are pointed out. R. P.

See Abstr. 739 530.145 : 535.325

MECHANICS

696 531 : 621.3

Electrical and mechanical analogies. MASON, W. P. *Bell Syst. Techn. J.*, 20, *pp.* 405–414, *Oct.*, 1941.

697 531.391

Analysis of longitudinal motions in trains of several cars. DUDLEY, W. M. *J. Appl. Mech.*, 8, A 145–A 151, *Dec.*, 1941.—Motion curves are given for a train of 5 uniform cars, also for one of 5 non-uniform cars, following a bump at one end. A motion curve is given for the uniform train when constant forces are applied in succession to the cars. Formulae for the natural frequencies and proportional amplitudes of a train of any length, if the cars are of uniform characteristics, are derived. The method of finite-difference calculus is used.

See Abstr. 677 531.391.5 : 517.433

698 531.552

Approximate mechanics of falling bodies. CRAWFORD, W. R. *Engineer, Lond.*, 172, *pp.* 430–432, *Dec.* 19, 1941.—The paper shows how the impact velocity, time of descent and horizontal travel, of a body falling through the atmosphere at a speed not exceeding that of sound may be estimated with reasonable accuracy. Assumptions made are: the motion takes place in a vertical plane, the reaction of the air is represented by a single force (the drag), and the falling body has an axis of symmetry which always coincides with the direction of motion of its c.g. It is further assumed that the drag coeff. is const. Two cases are considered, according as the air density is const. or varying with altitude. Expressions are worked out for velocity, time of descent and horizontal travel. G. E. A.

699 531.71 : 535.42 = 3

Range finding. LAU, E. *Z. techn. Phys.*, 21, 12, *pp.* 295–298, 1940.—[Abstr. 1969 (1941)].

700 531.719 : 621.317.39

How to measure the width of moving webs or strips. ALEXANDER, E. H. *Gen. Elect. Rev.*, 44, *pp.* 615–617, *Nov.*, 1941.—[Abstr. 407 B (1942)].

See Abstr. 885 531.73 : 541.18

701 531.733

The use of a McLeod gauge in measuring small volumes. KEEVIL, N. B., ERRINGTON, R. F., AND NEWMAN, L. T. *Rev. Sci. Instrum.*, 12, *pp.* 609–611, *Dec.*, 1941.—Precautions for accurate measurements are discussed, particularly the necessity of determining the capillary depression from each set of readings. Applications to the determination of small quantities of He are given.

702 531.754

Rapid determination of the specific gravity of plastic materials. PALMER, H. F., AND JONES, W. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 864–867, *Dec.*, 1941.—The sp. gr. of a plastic material is indicated directly by a machine as a result of the controlled compression of a known weight of sample. The sp. gr. of unvulcanized reclaimed rubber or rubber compounds may be determined in approx. 1 min.

703 531.767 : 621.317.39

R.f. device for detecting the passage of a bullet. BRADFORD, C. I. *Proc. Inst. Radio Engrs, N.Y.*, 29, *pp.* 578–583, *Nov.*, 1941.—A 3 500 kc./s. crystal oscillator has a work circuit coupled to it and tuned on the inductive side of resonance. The coil of this circuit is located on the trajectory of the bullet. Passage of the bullet through the coil causes the oscillator to take more anode current, with the result that a negative signal is applied to the grid of a valve acting as a distorting amplifier, insensitive to positive grid signals but highly sensitive to negative signals.

In the output stage a positive voltage output is obtained similar in shape to a resonance curve. By clipping and amplifying and then obtaining the derivative from the resistance unit of a resistor and capacitance in series, a very steep-fronted voltage is obtained, the steep front coinciding with the bullet being at the centre of the coil. Measurements are thus possible to within about $\frac{1}{8}$ in. and hence velocity measurements accurate to 0·5% can easily be made with a base 10 ft. in length, since for this accuracy the bullet location must be known to within about 0·5 in. The equipment has been in constant use for 2 years at the research ranges of the Remington Arms Company. A. W.

704 531.78 : 621.317.39

How to improve machine tool performance. HAND, A. R. *Gen. Elect. Rev.*, 44, *pp.* 605–607, *Nov.*, 1941.—[Abstr. 409 B (1942)].

LIQUIDS

705 532.13

The viscosities of aqueous solutions of some phenanthrenesulphonic acids. BOLAM, T. R., AND HOPE, J. *J. Chem. Soc.*, *pp.* 850–854, *Dec.*, 1941.—The viscosities of aqueous solutions of *p*-toluenesulphonic, phenanthrene-3-sulphonic, 9-bromophenanthrene-3-sulphonic, and 9-chlorophenanthrene-3-sulphonic acids have been measured at 18° over a considerable range of concentrations. Poiseuille's law was found to hold at the pressures employed. In the case of the halogenated acids there is an abnormal increase in the viscosity at concentrations in the neighbourhood of those at which the abnormal fall in conductivity occurs. The existence of 2 states of aggregation is indicated by a reversal in the behaviour of the acids: at relatively low concentrations the solutions of the bromo-acid are more viscous than those of the chloro-acid, but at higher concentrations the opposite is the case. It is confirmed that the addition of HCl produces a very large increase in the viscosity of solutions of the halogenated acids. The clear isotropic mixed solutions possess structural viscosity.

706 532.13

Anomalous viscosity of lubricating oil at high velocity gradients. NEALE, S. M. *Nature, Lond.*, 149, *p.* 51, *Jan.* 10, 1942.

See Abstr. 679 532.13 : 518.3

707 532.322

The effective wave slope. BAKER, G. S., AND BAKER, D. M. *Trans. Instn Nav. Archit., Lond.*, 83, *pp.* 1–7; *Disc.*, 7–10, 1941.—An investigation is made into the stability conditions which exist for a ship on a wave crest, the middle line of the ship and the wave crest being parallel. The ship's form is defined by tons/ft. at depth $x = kD \cos \theta$, and a formula is derived for the effective wave radius for the ship. Expressions are obtained for the rise of ship out of water and drop of C.B. relative to the ship when on the wave crest. Using these expressions, it is possible to estimate the loss of stability for 2 different types of motion which may occur under service conditions. The loss of metacentric height amounts to 0·45 ft. and 0·42 ft., the loss being independent of the initial value.

708 532.51

Application of the principle of similarity to hydrodynamical problems. KOERNER, C. F. *J. Instn Engrs Aust.*, 13, *pp.* 207–212, *Sept.*, 1941.—The principles of geometrical, cinematical and dynamical similarity are applied systematically and concisely to hydrodynamical problems and the procedure to be followed in designing hydrodynamic models, more especially models concerned with turbulent flow, e.g. orifice meters, is briefly discussed. J. S. G. T.

709 532.527

On the motion of vortices in two dimensions. LIN, C. C. *Proc. Nat. Acad. Sci., Wash.*, 27, *pp.* 570–577, *Dec.*, 1941.

710 532.542

The pressure wave system in the periodic flow of liquid in a pipe. SILVER, R. S. *Phil. Mag.*, 33, *pp.* 15–25, *Jan.*, 1942.—The flow of liquid in a horizontal pipe of uniform cross-section is investigated mathematically for the case in which the velocity of the liquid at the inlet is represented by simple harmonic fluctuations about a mean value, while at the other end the pipe adjoins another pipe of different cross-sectional area and of infinite length. The laws of reflection and transmission of pulses at the change of area, derived by the approx. treatment due to Diederichs and Pomeroy (*Trans. Amer. Soc. Mech. Engrs, Petroleum Section*, *p.* 46, *May–Aug.*, 1939) are shown to be true as a first approx. under normal conditions. Reflection conditions at an orifice through which fluid is forced are briefly discussed. J. S. G. T.

711 532.582 = 3

On prevention of boundary-layer turbulence through removal by suction. RAS, M., AND ACKERET, J. *Helv. Phys. Acta.*, 14, 5–6, *p.* 323, 1941.

712 532.583

The effect of shape of bow on ship resistance. III. EMERSON, A. *Trans. Instn Nav. Archit., Lond.*, 83, *pp.* 40–57; *Disc.*, 57–61, 1941.—The results of experiments with 13 models of prismatic coefficient 0·71 are given. An analysis of a considerable mass of single-screw data is given to show that for most forms the resistance up to 13 knots for the 400 ft. ship can be estimated from the wetted-surface coefficient and a simplified or equivalent angle of entrance.

See Abstr. 895 532.77 : 541.8

713 532.787 = 3

Germ formation in supersaturated solutions. AMSLER, J., AND SCHERRER, P. *Helv. Phys. Acta*, 14, 5–6, *pp.* 318–319, 1941.

GASES

714 533.21 : 536.76

The compressibilities of gaseous mixtures of methane and normal butane. The equation of state for gas mixtures. BEATTIE, J. A., STOCKMAYER, W. H., AND INGERSOLL, H. G. *J. Chem. Phys.*, 9, *pp.* 871–874, *Dec.*, 1941.—The compressibilities of 3 gaseous mixtures of methane and normal butane have been measured from 100° to 300°C. and from 1·25 to 10 mole/l. (max. pressure 350 atm.). The data on these 3 systems and the 2 pure hydrocarbons are used to study several methods of combination of constants in the Beattie–Bridgeman equation of state extended to apply to gas mixtures. The best results were obtained with square-root combination for A_0 and for c and Lorentz combination for B_0; but square-root combination for A_0 and linear combination for B_0 and for c are a fair compromise.

715 533.6.05 = 3

Practical results of aerodynamic measurements on ski-runners. STRAUMANN, R. *Helv. Phys. Acta*, 14, 5–6, *pp.* 311–313, 1941.

716 533.75 : 536.444

The region of critical solution of binary liquids, evidence for an anomalous first-order transition in the system triethyl-amine water. ROBERTS, L. D., AND MAYER, J. E. *J. Chem. Phys.*, 9, *pp.* 852–858, *Dec.*, 1941.—The change of fugacity with composition was investigated in the liquid system triethyl-amine water in the temperature region adjacent to the temperature of critical solution. It is shown that within experimental error this change is zero for a range of at least 5 deg. on the one-phase side, and for compositions of liquid between 20 and 50 wt.%. This is taken to be evidence for the existence of a range of anomalous first-order transition adjacent to the critical temperature. Values of change of fugacity with composition have been determined sufficiently precisely to be in definite disagreement with simple conclusions drawn from the concept of the continuity of states.

SOUND. VIBRATIONS

717 534.1 : 539.32

Determination of the static and dynamic constants by means of response curves. BERNHARD, R. K. *J. Appl. Phys.*, 12, *pp.* 866–874, *Dec.*, 1941.—The general characteristics of response curves of systems with 1 degree of freedom, excited by constant-force amplitudes and amplitudes increasing with the square of the exciting frequency, are discussed. Relations between displacement, velocity, power input and phase angle v. discord are compared for various damping values. Simple formulae are derived to determine by means of these response curves the static and dynamic constants of mechanical systems with one degree of freedom. A numerical example demonstrates the practical application.

718 534.21 = 3

Sound radiation pressure in liquids and gases in connection with the equation of state. HERTZ, G. *Z. techn. Phys.*, 21, 12, *pp.* 298–301, 1940.—[Abstr. 2138 (1941)].

719 534.213

Effect of distribution of masses in a frame floor on seismic structural vibration, and model experimental confirmations of that effect with a new vibration table. KANAI, K., AND SEZAWA, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 370–383, *Sept.*, 1940.—Mathematical solutions are found for the free vibrations of a frame floor with different distributions of mass and different span-height ratios. These are tested by means of a horizontally moving model table capable of vibrating with frequencies of range 0·5 to 50 per sec. The results are considered to go no further than to show the properties of the table. G. E. A.

720 534.213

Elastic waves from a point in an isotropic heterogeneous sphere. III. YOSIYAMA, R. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 185–205, *June*, 1941.—Solutions of the equation of motion of the elastic waves through a medium with the properties referred to are discussed, using the results obtained in previous papers. Two waves are propagated through the medium, a longitudinal wave advancing with velocity $\sqrt{(\lambda + 2\mu/\rho)}$, and the other, consisting of 2 types, A and B, both transverse, with velocity $\sqrt{(\mu/\rho)}$. Under certain conditions there are no transverse waves of type B. [See Abstr. 2398 (1940)]. G. E. A.

See Abstr. 923, 924 534.213 : 550.341

721 534.213 : 550.341 : 517.433

Transmission of arbitrary elastic waves from a spherical source, solved with operational calculus. I. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 151–161, *June*, 1941.—The case of an arbitrary disturbance occurring abruptly is discussed. The solution consists of 2 parts, the free oscillation and the forced oscillation. The period and logarithmic decrement of the free oscillation depend on the size of the spherical origin and the elastic nature of the surrounding medium.

722 534.22

Temperature variation of sound velocity in liquids. SURYAN, G. *Curr. Sci.*, 10, *p.* 489, *Nov.*, 1941.

See Abstr. 925 534.25 : 550.341

723 534.321

Note on the Doppler effect. MCILWRAITH, C. G. *Rev. Sci. Instrum.*, 12, *p.* 612, *Dec.*, 1941.

724 534.37 = 3

A new sound-absorbing arrangement of high efficiency and the construction of a highly damped sound chamber. MEYER, E., BUCHMANN, G., AND SCHOCH, A. *Z. techn. Phys.*, 21, 12, *pp.* 372–375, 1940 *Akust. Z.*, 5, *pp.* 352–364, 1940. *Abstr. in VDI* [*Z. Ver.*

dtsch. Ing.], 85, *p.* 567, *June* 21, 1941.—It is shown that an extraordinary degree of sound absorption can be reached by a continuous and gradual transition from air to the full density of absorbing material. The best arrangement is that in which the absorbing material is put on in the form of pyramids or wedges, forming "traps" for the sound. Slag wool was used for the absorbing material. The treatment of a room is described and its characteristics given. G. H. D.

725 534.414 = 3

Acoustic resonators and their coupling. ZICKENDRAHT, H. *Helv. Phys. Acta*, 14, 5–6, *pp.* 309–311, 1941.

726 534.811 = 4

Large accelerometer types of seismographs for horizontal and vertical components; construction and registrations. IIDA, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 514–530, *Dec.*, 1940.—Older types could seldom register the small shocks because of limited sensitivity, and when the registrations were obtained they were so doubtful that even with large optical magnification they could not be used. The apparatus here described has been in operation for 12 months and examples of the records are shown. Waves of short period, about 0·2 sec., are shown. The apparatus is expected to facilitate the study of short-period waves, the predominating period, the intensity and nature, and the relation with large shocks. R. S. R.

727 534.811 : 550.341 : 517.433

On the initial movement of a seismograph subjected to an arbitrary earthquake motion, solved with operational calculus. I. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 162–205, *June*, 1941.—The motion of the pendulum consists of 2 parts, a forced oscillation and a free oscillation. The initial motion of the pendulum is opposite in sense to that of the ground motion. In the case of a displacement seismometer the motion of the pendulum agrees with that of the ground, whereas in the acceleration seismometer it does not. When the disturbance occurs suddenly, the amount of initial displacement of the seismometer is the same as that of the ground motion, but in opposite sense. If the rapid ground motion begins with zero displacement and zero velocity, then, although the duration of the initial movement of the pendulum becomes very small, the amplitude is not abnormally large.

728 534.811 : 550.834

Seismic prospecting on a sea bottom. HAGIWARA, T., AND OMOTO, S. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 305–317, *June*, 1940.—Electromagnetic seismographs of the moving-coil and changing-flux types are described. Field work was carried out with the aid of artificial disturbances in the Ariake Sea and in the offing of a sea in Yamaguti prefecture to examine the geological structure of a coal field. The time/distance curves obtained are shown; the depths of the layers were found. R. S. R.

LIGHT

729 535.11

To prove that the energy of a photon (corpuscle) of light is proportional to the frequency of the light wave. HULL, G. F. *Amer. J. Phys.*, 9, *pp.* 379–380, *Dec.*, 1941.

730 535.215

Photo-electric properties of bismuth. JUPNIK, H. *Phys. Rev.*, 60, *pp.* 884–889, *Dec.* 15, 1941.—Photo-electric threshold determinations with Fowler plots were made for 6 Bi surfaces evaporated on glass under high-vacuum conditions. The values obtained for the work function were all between 4·22 and 4·25 eV. There was no significant temperature variation over the range −70°C. to 200°C. for the wavelength 2 537 Å, but the data indicated contamination at the lower temperatures. Values of the parameter α, the number of electrons that strike unit area of the surface per sec. and absorb a quantum of energy when the light intensity is 1, were obtained for the Bi surfaces and found to be 0·03 to 0·1 as great as those of Na surfaces. Like those, the values of α are $\sim 10^{-2}$ as great as the upper limit if the number of free electrons per Bi atom is assumed to be 5.

731 535.215.5 = 3

Photo-electric investigation of thin tantalum oxide layers produced by electrolysis. BÄR, W. *Z. Phys.*, 115, 11–12, *pp.* 658–677, 1940.—Sheet Ta used as anode in diluted H_2SO_4 is covered by electrolysis with a thin layer of Ta_2O_5. As soon as the current has decayed to a very small value, these sheets, placed in the electrolyte near the surface and still connected with the voltage, are intensely illuminated with light from a mercury quartz lamp. Very intense photo-electric currents are observed, which show inertia and fatigue. At the same time, the residual currents are enormously increased by the illumination. This indicates that the Ta_2O_5 grating is perturbed by the illumination. The rate of formation of the oxide layers is smaller with illumination than without it. Furthermore, the capacitance of the oxide layer decreases at the illumination while at the same time the photo-electric current decreases. The space charges coming out of illuminated layers are greater than those from non-illuminated layers. Only ultra-violet light of short wavelength is effective. The photo-electric current is not exactly proportional to the intensity of illumination. Fluorescence phenomena are observed in the oxide layer during illumination. O. O.

732 535.230.8

Radiant-energy measurements with thermopiles. BEESE, N. C. *J. Opt. Soc. Amer.*, 31, *pp.* 705–708, *Nov.*, 1941.—It is found that a carbon-coated thermopile gives smaller readings on ultra-violet lamps when

the thermopile is evacuated than when it is filled with air or other gases. The transparency of the carbon coating for long-wavelength radiations and its opacity to short wavelengths, requiring the presence of gas molecules to transport part of the ultra-violet energy from the front surface to the thermal junctions, explains the observed phenomenon. A thermopile having a coating of platinum black gives the same values whether evacuated or air-filled, because a thin coating of platinum black is an excellent absorber for all wavelengths. A. H.

733 535.24

Photometric method for estimation of minute amounts of mercury. BALLARD, A. E., AND THORNTON, C. D. W. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 893–897, *Dec.*, 1941.

734 535.243

A quartz photo-electric spectrophotometer. CARY, H. H., AND BECKMAN, A. O. *J. Opt. Soc. Amer.*, 31, *pp.* 682–689, *Nov.*, 1941.—The speed and convenience of spectrophotometric determinations can be greatly increased by the use of a direct-reading potentiometer, electronic amplifier and rugged balance-indicating meter. A photo-electric spectrometer is described which incorporates these features for measurements in the ultra-violet and visible regions. The dispersing element is a quartz prism, measurements being made to show that this has a decided advantage over a grating with respect to scattered light. A. H.

735 535.243

Photometry in spectrochemical analysis. PIERCE, W. C., AND NACHTRIEB, N. H. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 774–781, *Nov.* 15, 1941.—A study is made of the photometric methods used in spectrochemical analyses and the procedures found to give optimum results are listed. Included in the study are methods for plate calibration, the variation in plate gamma with wavelength, the effect of background and methods for correcting, and the accuracy obtained in photometric measurements of intensity ratios. Working curves and the factors governing the selection of an internal standard are discussed. Graphical computation methods are described. Criteria for evaluation of a photometer are given and the construction of a satisfactory instrument is described. A. H.

736 535.245 : 77.011

The brightness scale of exterior scenes and the computation of correct photographic exposure. JONES, L. A., AND CONDIT, H. R. *Commun. No.* 813 *Kodak Res. Lab. J. Opt. Soc. Amer.*, 31, *pp.* 651–678, *Nov.*, 1941.—The max. and min. brightness of 126 exterior scenes of a wide variety of types has been measured. From these data it is found that the average brightness scale is 160. Exterior scenes can be classified by inspection into a relatively few groups which are quite homogeneous with respect to brightness characteristics, especially as regards min. brightness. A formula for the computation of correct exposure time based upon the min. brightness of the scene has been derived. Exposure times as computed by this formula for typical scene groups based on the above classification agree very well with those which have been found by long experience to give satisfactory results. A. H.

737 535.247

A geared photometer turntable suitable for surfaces of low gloss. BARKAS, W. W. *J. Sci. Instrum.*, 19, *pp.* 26–29, *Feb.*, 1942.—The construction is described of a gear which fulfils the condition that the test surface should rotate through $\frac{1}{2}$ the angle of the arm carrying the illuminating beam of light when the scattered flux is collected by a stationary photocell. The advantage of this arrangement is that, whatever the angle of the illuminating beam, the light thrown on to the photocell is reflected by the same set of mirror facets in the test surface, facets of a particular orientation being chosen in advance. The gear is constructed of standard Meccano components and is free from backlash.

738 535.247 : 523.81

A photo-electric star counter. MCCUSKEY, S. W., AND SCOTT, R. M. *Rev. Sci. Instrum.*, 12, *pp.* 597–601, *Dec.*, 1941.—The star images to be photometered are manually shifted into the optical focus of the device. The results of tests indicate greater accuracy in counting than is attainable by visual means. No systematic deviations of the counts so obtained from catalogue compilations, or from the results deduced visually, were found.

See Abstr. 792 535.3 : 548.73 : 537.531

739 535.325 : 530.145 = 3

Density fluctuations and light scattering in Bose–Einstein and Fermi–Dirac gas. FURSSOW, W., BELENSKY, S., AND GALANIN, A. *J. Phys., U.S.S.R.*, 4, 4, *pp.* 349–355, 1941.—The intensity of light scattered in a gas because of density fluctuations is calculated by means of quantum statistics. It is shown, in particular, that a Bose–Einstein gas shows very strong scattering near the condensation point. It is suggested that scattering measurements should be carried out in liquid He in order to test the analogy with a degenerate Bose–Einstein gas. R. P.

740 535.33 : 543.9

Spectrochemical determination of trace metals in biological material. CHOLAK, J., AND STORY, R. V. *J. Opt. Soc. Amer.*, 31, *pp.* 730–738, *Dec.*, 1941.

741 535.338

The long-wave emission and fluorescence spectra ($\lambda\lambda$5 700–3 000 Å) of ordinary HgCl and of artificially enriched $Hg^{37}Cl$. WIELAND, K. *Helv. Phys. Acta*, 14, 5–6, *pp.* 420–464, 1941.—The extensive band spectrum β of HgCl from 5 700–3 000 Å has been investigated by emission and fluorescence spectra methods.

Similar studies have been made with $Hg^{37}Cl$ (92% enriched). This has led to a clearing-up of the unusual structure of the complete spectrum and a universal band-head formula has been derived for bands degraded towards the red. Other features of the spectra are discussed and the following constants are evaluated: $\omega_0'' = 291{\cdot}0$; $\omega_0' = 191{\cdot}5$; $\nu_{00} = 23\,371{\cdot}0$ cm.$^{-1}$ (2·90 V); $D_0'' = 1{\cdot}04$ eV and $D_0' = 2{\cdot}69$ eV. The atom term difference of the dissociation limits, v_a, is 4·55 eV. The upper electron state is probably an ionic state of the molecule, Hg^+Cl^-, but, whether or not this is accepted, the β band system is considered to be most probably a $^2\Sigma+ \rightarrow {}^2\Sigma+$ transition. W. R. A.

742 535.338

Further resolution of two parallel bands of ammonia and the interaction between vibration and rotation. Sheng Hsi-yin, Barker, E. F., and Dennison, D. M. *Phys. Rev.*, 60, *pp.* 786–794, *Dec.* 1, 1941.—The fundamental l.f. parallel bands of NH_3 at 10 and 16 μ have been re-examined under high dispersion and lines, previously reported as single, are resolved into multiplets. An equation is given for the positions of the lines and the const. of this equation have been determined from experimental data. Rotational const. consist of 2 quantities, the const. averaged over the 2 levels of the double min., and the difference of the const., which, in effect, arises from the change in the splitting of the 2 levels of the double min. due to vibration-rotation interaction and its evaluation is discussed. Calculated and observed values are in excellent agreement. W. R. A.

743 535.338

New classifications in the spectra of Au I and Au II. Platt, J. R., and Sawyer, R. A. *Phys. Rev.*, 60, *pp.* 866–876, *Dec.* 15, 1941.—Measurements have been made on the spectrum of Au excited in a hollow-cathode discharge in He. In the region investigated (600 Å–10 000 Å) some 2 000 new lines were found, of which 237 have been newly classified in the arc spectrum and 83 in the first spark spectrum. In the arc spectrum the *ns* and *nd* series have been extended to $n = 14$, and new values of the $5f\,^2F$ levels are suggested. The series limit, $5d^{10}\,{}^1S_0$ of Au II, is calculated to be 74 410 cm.$^{-1}$ above the ground state, $5d^{10}6s\,{}^2S_{\frac{1}{2}}$, of Au I. Several new terms above the series limit have been located. In the first spark spectrum the resonance triplet has been confirmed. The lowest 6 members of the $5d^9 7p$ group have been found, and the $5d^8 6s^2$ configuration has been completed.

744 535.338

Isotope effect in the predissociation phenomena of the CH and CD molecules. Gerö, L., and Schmid, R. F. *Phys. Rev.*, 60, *pp.* 911–912, *Dec.* 15, 1941.

745 535.338

The Fe Kβ' and Kβ_5 lines of FeS_2 and Fe_2O_3. McDonald, J. C. *Phys. Rev.*, 60, *p.* 912, *Dec.* 15, 1942.

746 535.338

Structure of the electronic bands of the OD molecule. II. Sastry, M. G. *Indian J. Phys.*, 15, *pp.* 95–102, *April*, 1941.—In continuation of the work on the structure of the OD bands of heavy water [Abstr. 2625 (1941)] the (3,0) band at λ2 569 was photographed with a Hilger quartz spectrograph. An exposure of about 5 hr. was necessary. By extrapolation the rotational structure of this band was analysed. The values of the constants are found to be $B_3'' = 8{\cdot}13$, $B_0' = 9{\cdot}94$ and the spin coupling constant $A = -139{\cdot}6$ cm.$^{-1}$.

747 535.338 : 539.132

The near infra-red spectra of linear Y_2X_2 molecules. I. Theory. Shaffer, W. H., and Nielsen, A. H. *J. Chem. Phys.*, 9, *pp.* 847–852, *Dec.*, 1941.—Complete expressions for the rotation-vibration energies of the linear Y_2X_2 molecules, through second order of approximation, have been obtained in the form $E = hc(G_V + F_R)$. The vibrational term G_V obtained agrees exactly with that found by Wu and Kiang, but there are numerous points of difference in the rotational term F_R.

748 535.341 = 3

A quantitative measurement of the absorption of light by benzene and its derivatives in the near infra-red. Kempter, H. *Z. Phys.*, 116, 1–2, *pp.* 1–18, 1940.—A photo-electric method is described which allows the measurement of the absorption of light in the near infra-red (7 000 to 11 000 Å), making changes of 0·1% noticeable. The proportionality between the intensity of absorption by a CH-band and the number of CH valences of equal saturation is discussed, taking into account 11 benzene derivatives. O. O.

749 535.341 = 3

Pressure dependence of the absorption of light by oxygen at 2 144 Å. Heilpern, W. *Helv. Phys. Acta*, 14, 5–6, *pp.* 329–354, 1941.—The absorption of light by O_2 in the region of its continuous absorption at 2 144 Å has been studied at atm. and reduced pressure. The absorption does not fulfil Beer's law; the coeff. of extinction is $\propto$ (pressure)$^{1{\cdot}55}$. The absorption of air and of O_2-N_2 mixtures has been measured in the same region and it is found that the absorption of O_2 is enhanced by the addition of N_2, itself non-absorbing in this region. W. R. A.

750 535.342 = 3

Density dependence of the shift of the high alkali series lines by other gases. Füchtbauer, C., and Häusler, G. *Z. techn. Phys.*, 21, 12, *pp.* 307–311, 1940.—[Abstr. 2093 (1941)].

751 535.342 + 536.42 = 3

Vapour pressure and band spectrum of tellurium dichloride. Wehrli, M., and Gutzwiller, N. *Helv. Phys. Acta*, 14, 5–6, *pp.* 307–309, 1941.

752 535.342 : 539.23 = 3

The optical anomaly of thin metal layers explained on the basis of fluctuations of density. WOLTER, H. *Z. Phys.*, 115, 11–12, *pp.* 696–706, 1940.—The optical anomaly of thin metal layers is frequently noticeable by the appearance of resonance in the absorption spectrum. In other cases, e.g. with thin Pt layers, the thinnest layers show a variation of the absorption with the wavelength contrary to the behaviour of the solid metal. Both kinds of anomaly, for Au and for Pt, are explained by the same assumption. This is that the average density of the metal in thin layers is slightly less than for the solid metal and, in addition, that it varies from one point to another. O. O.

753 535.343 = 3

Absorption and fluorescence spectra of triatomic indium and gallium halides. WENK, W. *Helv. Phys. Acta*, 14, 5–6, *pp.* 355–382, 1941.—The absorption of the vapours of $InCl_2$, $InBr_2$, InI_2 and $GaCl_2$, has been studied between 5 000 and 1 500 Å. Each compound exhibits 4 continua, K_a, K_b, K_c and K_d, whose max. appear successively at increasing pressure from 0·001 to 1 mm. pressure. K_d is not exhibited by InI_2. In passing from chloride to bromide to iodide the absorption max. are systematically displaced to longer wavelengths. Fluorescence spectra on the In halides provide an interpolation of the continua K_c and K_d. The absorbed radiation brings about a photo-dissociation. The triatomic halide splits off a halogen atom and the resulting diatomic halide emits as fluorescent light 2 band systems already known in emission and absorption. The upper limits for the work of separation of a halogen atom from the triatomic halide molecules are given as: $InCl_2$, 2·06 eV; $InBr_2$, 1·83 eV; InI_2, 1·96 eV. With sufficiently short wave excitation the fluorescence spectrum of $InCl_2$ contains also the 2 In lines, 4 102 and 4 511 Å, which are produced by the photo-dissociation of InCl which is always present in the vapour of $InCl_2$. The most effective excitation of these fluorescence lines is produced in $InCl_2$ by 1 640 Å, and in $InBr_2$ by 1 830 Å. The upper limits for the dissociation works of InCl and InBr are 4·51 and 3·74 eV. The vapours of InCl and $InCl_3$ each exhibit an absorption continuum in the Schumann region, the long-wave limit of which moves towards the visible with increasing temperature and pressure. W. R. A.

754 535.343.3 = 3

Absorption of light by liquid H_2O and D_2O in the infra-red between 5 μ and 27 μ. SOHM, M. *Z. Phys.*, 116, 1–2, *pp.* 34–46, 1940.—The absorption spectra of liquid H_2O and D_2O are photographed with layers of several μ thickness, starting from the range of molecular vibrations up to a wavelength of 27 μ. A group of nearly equidistant absorption lines was observed beginning at 14 μ and 19 μ for H_2O and D_2O respectively. O. O.

755 535.37 = 3

The half-value time of fluorescence radiation. KIRCHHOFF, W. *Z. Phys.*, 116, 1–2, *pp.* 115–121, 1940.—An improved fluorometer is described. It has been applied to measurements with solutions of fluorescein and eosin. The half-value time of pseudo-isocyanin and similar dyes is $< 10^{-9}$ sec. O. O.

756 535.39 = 3

The influence of reflection on the effect of double-refracting plates. GABLER, F., AND SOKOB, P. *Z. Phys.*, 116, 1–2, *pp.* 47–55, 1940.—The reflection of light occurring at the surfaces of a double-refracting plate has a considerable effect on the polarization of the light transmitted. This effect is theoretically treated. O. O.

757 535.414 : 545

The analysis of toluene for benzene by an ultra-violet absorption of vapour mixtures and the determination of concentration of toluene in air by use of the Rayleigh–Jeans interference refractometer. COLE, P. A., AND ARMSTRONG, D. W. *J. Opt. Soc. Amer.*, 31, *pp.* 740–742, *Dec.*, 1941.—A method is described, useful in the range of conc. of benzene from 0·01% to 10%. The use of the Rayleigh–Jeans interference refractometer in the control of conc. of toluene vapour in an exposure chamber suitable for toxicological investigations is described. At low conc., with the bubbler used, the control is within 5% of the amount present; at higher conc. the control is within 10%.

See Abstr. 699 535.42 : 531.71

758 535.43 : 539.37 = 3

Use of the Tyndall effect for determination of strains in transparent solids. MENGES, H. J. *Z. techn. Phys.*, 21, 12, *pp.* 384–386, 1940.—To the state of strain in the interior of a deformed transparent model corresponds the polarization of light passing through it. Such states of strain may accordingly be determined by the Tyndall effect. An optical system consisting of mercury lamp, filter and lens, provides a beam of monochromatic light, some of which is passed through a diaphragm, nicol prism, and transparent test body, all 3 of which can be rotated about a common axis and set at a determined angle. A tube with a lens and photo-electric cell is mounted so that light scattered at rt. angles from any small portion of the polarized beam may be focused on the cell for measurement. A résumé of the theory is given and preliminary results show satisfactory agreement. G. H. D.

759 535.6

Colour measurement. *Nature, Lond.*, 149, *pp.* 76–77, *Jan.* 17, *and pp.* 247–248, *Feb.* 28, 1942.—Correspondence. [See Abstr. 111 (1942)].

760 535.767 = 3

New phenomena of physiological optics. GEHRKE, E. *Z. techn. Phys.*, 21, 12, *pp.* 292–295, 1940.—[Abstr. 2104 (1941)].

761 535.827.11

Permanent labels for microscope slides. SAHNI, B. *Curr. Sci.*, 10, *pp.* 485–486, *Nov.*, 1941.

762 535.827.11

An indigenous mounting medium for microscopic work. KAUL, K. N., MUKERJI, B., AND CHOPRA, R. N. *Curr. Sci.*, 10, *pp.* 486–488, *Nov.*, 1941.

763 535.87

Layout scheme for plane mirror systems. KLIEVER, W. H. *Rev. Sci. Instrum.*, 12, *p.* 612, *Dec.*, 1941.

HEAT

764 536 = 3

Progress in research in heat technology. SCHMIDT, E. *VDI* [*Z. Ver. dtsch. Ing.*], 85, *pp.* 163–167, *Feb.* 15, 1941.—A comprehensive report on 14 papers read at the main meeting 1939 of the V.D.I. and at the meeting of its committee on heat research 1940. The following subjects were dealt with: A semi-empirical equation of state for liquids, Eucken, A.; The triple law of CO_2, Planck, R.; Experiences in construction and operation of an expansion piston engine for very low temperatures, Meissner, W.; On piezo-electric pressure meters of high natural frequency, Gohlke, W.; Quantity measurement at pulsating flow, Schultz-Grunow, F.; Calculation of the temperature field in the laminar boundary layer of unheated bodies with rapid advection of heat, Eckert, E.; A simple appliance for determining the heat conductivity of synthetic materials, Koch, W.; Heat and temperature conductivities of carbon, Fritz, W., Moser, H., and Diemke, H.; Measurements of heat conductivity of organic liquids, Riedel, L.; Measurement of heat conductivity of liquids, Schmidt, E.; On extrapolation of measurements of infra-red radiation of CO_2 and steam, Schack, A.; On the process of evaporation, Prüger, W.; Exchange of heat and material at drying of moist substances, Kirschbaum, E.; Model similarity at the material exchange during flow, Matz, W. R. N.

765 536.212.3

Thermal conductivity of dielectrics at temperatures higher than the Debye temperature. POMERANCHUK, I. *J. Phys., U.S.S.R.*, 4, 3, *pp.* 259–268, 1941.—The thermal conductivity of dielectric crystals at high temperatures depends on the dispersion of sound waves in the crystal. If the dispersion curve does not satisfy certain conditions, the thermal resistance of the crystal is proportional to $T^{3/2}$ as against T in the case considered by Peierls. R. P.

766 536.212.3

Thermal conductivity of the paramagnetic dielectrics at low temperatures. POMERANCHUK, I. *J. Phys., U.S.S.R.*, 4, 4, *pp.* 356–374, 1941.—In the temperature range in which the magnetic energy of a paramagnetic crystal gives an important contribution to its heat content, the transport of magnetic energy also gives an important contribution to the thermal conductivity. The temperature dependence of this effect is very complicated, and observations on this would allow one to draw conclusions about the magnetic forces. R. P.

767 536.212.3

On the thermal conductivity of dielectrics. POMERANCHUK, I. *Phys. Rev.*, 60, *pp.* 820–821, *Dec.* 1, 1941.—Peierls and Debye found that, if $T \gg \theta$ (T is the temperature, θ the Debye temperature), the thermal conductivity κ of dielectrics varies inversely as the temperature. This is true only for dielectrics obeying the definite law of sound velocity dispersion and the definite law of the dependence of sound velocity on the direction. For all other dielectrics at $T \gg \theta$, $\kappa \propto T^{-3/2}$. This results from investigation of the free path of long elastic waves.

768 536.24

Mean temperature difference in multi-pass exchangers. GARDNER, K. A. *Industr. Engng Chem.*, 33, *pp.* 1495–1500, *Dec.*, 1941.—Mean temperature-difference correction factors are presented for heat exchangers where the shell fluid is not mixed. These factors are shown to be higher than those for exchangers with the shell fluid completely mixed for the same temperature conditions. The limits within which the true correction factors may vary due to an unknown degree of mixing are thus defined by Nagle's curves (lower limit) [Abstr. 1882 (1933)] and the author's (upper limit). Conditions are discussed under which it may be desirable to design a heat exchanger deliberately to prevent mixing of the shell fluid.

769 536.242 : 621.385.032.42

Temperature distribution in vacuum-tube coolers with forced-air cooling. MOUROMTSEFF, I. E. *J. Appl. Phys.*, 12, *pp.* 491–497, *June*, 1941.—[Abstr. 441 B (1942)].

770 536.252

The study of heat transfer in helium II. KAPITZA, P. L. *J. Phys., U.S.S.R.*, 4, 3, *pp.* 181–210, 1941.—Experiments are made on the heat transport in liquid He II, and it is established that the conductivity is reduced to normal values when the liquid in a capillary is set into motion. It was, in fact, shown that the flow in a capillary is made up of 2 parts, one along the walls of the capillary and another in the opposite direction down the centre. The heat transfer from a body suspended freely in liquid He shows no abnormally large conductivity. R. P.

See Abstr. 751 536.42

771 536.42 : 621.365.2 = 3

Boiling point and melting point of carbon and the temperature of the positive crater. PODSZUS, E. *Z. Phys.*, 115, 11–12, *pp.* 651–657, 1940.—Observed values of the absorptivity of C lead to a v.p. curve for diatomic C vapour from which the b.p. at atm. pressure is derived (4 500°). The loss of material

observed agrees with the loss computed from the v.p. The heat of evaporation of diatomic C is 194 k.cal. The share of the continuous radiation from the vapour at 5 atm. and 50 A is more than 30%. The m.p. of C is near 4 700°. O. O.

772 536.421.1

Effect of soft glass on melting point of rotenone. JONES, H. A. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *p.* 819, *Nov.* 15, 1941.

773 536.423 = 3

On the elementary vaporization process. MIESCHER, E. *Helv. Phys. Acta*, 14, 5–6, *pp.* 320–321, 1941.

774 536.44

Determination of Beattie–Bridgeman constants from critical data. BROWN, F. W. *Industr. Engng Chem.*, 33, *pp.* 1536–1537, *Dec.*, 1941.—The theoretical basis for the procedure of Maron and Turnbull [Abstr. 1042 (1941)] is discussed, and the constants for hydrogen are recalculated on the basis of the Lennard-Jones model of intermolecular forces.

See Abstr. 716 536.444 : 533.75

775 536.532 : 621.317.39

A method of installing tube-wall thermocouples. PATTON, E. L., AND FEAGAN, JR., R. A. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 823–824, *Nov.* 15, 1941.

776 536.58

An adjustable vapour thermoregulator. YEE, J. Y. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *p.* 839, *Nov.* 15, 1941.

777 536.587 : 621.316.74

Electronic pyrometer control. MACLAREN, F. B. *Electronics*, 14, *pp.* 50 and 78, *Nov.*, 1941.—[Abstr. 399 B (1942)].

778 536.662

Heats of combustion. I. The heat of combustion of acetone. MILES, C. B., AND HUNT, H. *J. Phys. Chem.*, 45, *pp.* 1346–1359, *Dec.*, 1941.—The paper describes a modification of existing apparatus and technique for precision determinations of readily volatile organic compounds. The heat of combustion of acetone has been re-determined with an absolute accuracy within $\pm 0{\cdot}05\%$.

779 536.75

The entropy of acetic acid. HALFORD, J. O. *J. Chem. Phys.*, 9, *pp.* 859–863, *Dec.*, 1941.—From third-law measurements, vapour pressures and vapour densities, the entropy of the acetic acid monomer at 25° and 1 atm. is $69{\cdot}4 \pm 1{\cdot}0$ e.u. The value $68{\cdot}7$ is calculated from the vapour-phase ethyl-acetate equilibrium. For a model based upon acetone and approx. representing free rotation the entropy would be $72{\cdot}7$. If there is only a single potential min. in the hydroxyl group rotational cycle, the large deficiency below the free rotation value is explained without assuming an exceptionally high potential barrier. A brief discussion of the effect of the number of potential min. and their relative depth is appended, and a possible source of error in third-law measurements is suggested.

780 536.76

Second-virial coefficients of polar gas mixtures. STOCKMAYER, W. H. *J. Chem. Phys.*, 9, *pp.* 863–870, Dec., 1941.—An empirical equation used by Keyes to represent the second-virial coefficients of several polar gases is compared with a theoretical expression for the same quantity. The constants appearing in this equation are discussed in terms of intermolecular forces, and their relationship to analogous constants in the Beattie–Bridgeman equation for non-polar gases is examined. These considerations permit the construction of simple rules by means of which the second-virial coefficient of any gas mixture may be calculated if the coefficients and dipole moments of the pure component gases are known. The success of these rules is demonstrated by comparison with data on H_2O–CO_2, N_2–NH_3, and N_2–H_2O systems. In the case of N_2–H_2O mixtures (vapour-liquid equilibrium data) the agreement is not satisfactory at the higher temperatures. A rough method of including the effect of higher-virial coefficients reduces, but does not remove, this discrepancy.

See Abstr. 714. 536.76 : 533.21

ELECTRICITY

781 537.122

Anisotropy of the electronic work function of metals. SMOLUCHOWSKI, R. *Phys. Rev.*, 60, *pp.* 661–674, *Nov.* 1, 1941.—Theories so far put forward to explain the different values of the work function for the different faces of a crystal give either an incorrect sequence or a wrong order of magnitude when compared with experimental facts. The theory of Wigner and Bardeen, according to which the work function is the sum of a volume contribution and a contribution due to a double layer on the surface of the metal, is used as the basis of a more satisfactory explanation. Some general formulae for these double layers are derived and discussed more fully in the case of a simple cubic and a body-centred cubic lattice. When applied to the W crystal, results agree satisfactorily with experiment, assuming a reasonable density of free electrons. The surface energies are calculated and found to agree with the observed stability of certain crystal faces. A. J. M.

See Abstr. 886 537.226 : 541.18

782 537.226.33 = 3

Hysteresis loops of KD_2PO_4 crystals. BANTLE, W., AND SCHERRER, P. *Helv. Phys. Acta*, 14, 5–6, *pp.* 316–318, 1941.

See Abstr. 902 537.228.1 : 548

783 537.311 : 538.632

The electrical conductivity of zinc oxide. MILLER, JR., P. H. *Phys. Rev.*, 60, *pp.* 890–895, *Dec.* 15, 1941.

—The electrical conductivity of ZnO for an average sample obeys the following equations, $\sigma = 10^{-2} \exp(-2 \times 10^{-2}/kT)\,\Omega^{-1}\,\text{cm.}^{-1}$ for $T < 25°\text{C.}$ and $\sigma = 10^{2} \exp(-7 \times 10^{-1}/kT)\,\Omega^{-1}\,\text{cm.}^{-1}$ for $400°\text{C.} < T < 700°\text{C.}$ The conductivity in the lower temperature range is believed to be due to the ionization of interstitial Zn atom pairs, whose ionization energy is 2×10^{-2} eV or less. Conductivity of this type reaches saturation about room temperature. In the higher temperature range the conductivity is caused by the ionization of single interstitial Zn atoms, whose ionization energy is 7×10^{-1} eV. At 800°C. the conductivity of this type begins to reach saturation. Hall-effect measurements show the free electron density to be about 10^{15} cm.$^{-3}$ at room temperature. The fraction of pairs existing is 10^{-3} which is a factor of 10 larger than the *a priori* probability.

784 537.311.1 = 3

Metal electrons in the gravitational field of the earth. Wolf, F. *Z. techn. Phys.*, 21, 12, *pp.* 325–327, 1940.—[Abstr. 1910 (1941)].

785 537.311.33 : 621.314.63 = 3

Deviations from Ohm's law in semi-conductors. Schottky, W. *Z. techn. Phys.*, 21, 12, *pp.* 322–325, 1940.—[Abstr. 1395 B (1941)].

786 537.312.8 = 3

Resistance increase in magnetic fields and conduction types of the metals. Justi, E. *Z. techn. Phys.*, 21, 12, *pp.* 315–321, 1940.—[Abstr. 2187 (1941)].

See Abstr. 903 537.312.8 : 548

See Abstr. 897 537.36 : 542.64

787 537.361

Immobile layer at the solid/liquid interface. Bikerman, J. J. *Phys. Rev.*, 60, *p.* 880, *Dec.* 1, 1941.

788 537.523.3 : 621.3.015.532

Pulses in negative point-to-plane corona. Loeb, L. B., Kip, A. F., Hudson, G. G., Bennett, W. H. *Phys. Rev.*, 60, *pp.* 714–722, *Nov.* 15, 1941.—Further study of the pulses reported by Trichel for negative points in room air shows that the onset potentials and the current/voltage characteristics of the corona showing such pulses are independent of the metal and thus of the work function of the point. Bennett's work indicates that the mechanism of the pulses depends entirely on the nature of the field about the point in air and that the pulses occur only in gases attaching electrons to form a space charge cloud of slowly moving negative ions, whose time of movement across a critical region in the gap determines the frequency of the pulses. The pulses also require the presence of a source of triggering electrons. These results explain why dusty room air readily gives such pulsating effects while clean, dry, dust-free air yields random bursts of pulses of irregular form. Trichel's theory of the effect appears to be applicable except as modified by the influence of the negative ion space charge and the necessity of triggering electrons. A. W.

789 537.523.5 = 3

The minimum potential for maintaining a discharge. Rossbach, P., and Seeliger, R. *Z. Phys.*, 116, 1–2, *pp.* 68–72, 1940.—By the conventional method of bringing the electrodes in touch with each other, the min. potential required for an arc cannot be measured with an error < 1V, in particular with rapidly evaporating or burning electrodes. The sum of the cathode- and anode-drops can be measured only within the same limits. O. O.

790 537.523.5 : 621.325.1 = 3

The cause of hissing of the homogeneous carbon arc. Weizel, W., and Fassbender, J. *Z. techn. Phys.*, 21, 12, *pp.* 391–393, 1940.—In order to clear up the cause of the hissing noise which often occurs in a carbon arc with homogeneous electrodes and high current density, the anode which is responsible for the hissing was photographed on a moving film with 1 500 exposures/sec., each of 1/150 000 sec. duration. The pictures show that the arc does not originate uniformly on the whole top of the anode but in a small spot which moves with great velocity. Oscillograms show that the arc voltage fluctuates irregularly with an average frequency of 1 000 c./s. and that these voltage fluctuations are correlated with the sound amplitudes. The authors think that the mechanism of the hissing arc is as follows: at the anode spot the temperature of the carbon becomes very high. Gases which are driven out there raise the voltage and in a short time it becomes so high that the arc is forced to jump to a neighbouring spot where the procedure repeats itself. G. H. D.

791 537.523.5 : 621.325.1 = 3

Brightness of the + crater of the pure carbon arc and the temperature of volatilization of carbon. Finkelnburg, W. *Z. techn. Phys.*, 21, 12, *pp.* 311–315, 1940.—[Abstr. 2080 (1941)].

792 537.531 : 535.3 : 548.73

X-ray reflections of the second kind in metallic crystals. Dayal, B. *Proc. Indian Acad. Sci. A*, 14, *pp.* 421–425, *Oct.*, 1941.—The (200), (111), (220) and (222) Raman reflections from single crystals of Al have been studied for a large number of settings of the crystal. The position, sharpness and angular width, of the new spots point to their being a new type of reflection and not diffuse max. of X-ray scattering. The positions of the spots indicate that the angle between the crystallographic planes and the phase waves does not differ very much from 90°.

793 537.531 : 535.3 : 548.73

Quantum theory of X-ray reflection: basic ideas—Mathematical formulation. Experimental confirmation. Raman, C. V., and Nilakantan, P. *Proc. Indian Acad. Sci. A*, 14, *pp.* 317–376, *Oct.*, 1941.—The paper examines the views,

current at the present time regarding the nature of the vibrations possible in a crystal lattice, which are based largely on the sp. ht. theory of Debye and the crystal dynamics of Born. The latter has for its starting point the so-called postulate of the cyclic lattice. This is an *ad hoc* supposition adopted for mathematical convenience and its consequences are contradicted by the known spectroscopic behaviour of crystals; it is also contrary to the dynamic behaviour of coupled Planck oscillators such as the lattice cells of a crystal. The modes of vibration of the elastic type forming a continuous spectrum and the modes of vibration having monochromatic frequencies in the infra-red have fundamentally different dynamic characters. The infra-red vibrations result in geometric reflections by the lattice planes of the crystal but with altered frequency, their intensity being proportional to the square of the number, N, of lattice cells in the crystal. The elastic vibrations of low frequency give a diffuse scattering of the X-rays of which the intensity is proportional to N. As both these effects involve changes of frequency, the classical mechanics is incompetent to describe them correctly and has therefore to be replaced by quantum-mechanical considerations. The paper presents the experimental evidence furnished by the X-ray studies with diamond, which confirms the theoretical ideas and mathematical formulation. The nature of the vibrations of the crystal lattice of diamond is discussed with special reference to the mode having a frequency of 1 332 wave numbers. This vibration gives a large variation of the structure amplitude of the (111) crystal planes, while other vibrations of a different character leave it unaffected. The X-ray reflections of the second kind given by these planes are truly specular in character. Measurements of the geometric positions of the reflections over a wide range of crystal settings show complete agreement with the formula, the phase waves of the vibrations appearing parallel to the (100) planes of the crystal. Symmetry demands that there should be 3 such sets of phase waves, and this is substantiated by the experimental facts. The quantum reflection moves out of the plane of incidence when the crystal plate is rotated in azimuth.

794 537.531 : 535.3 : 548.73

A quantum theoretical explanation of the appearance of forbidden X-ray reflections in diamond. PISHAROTY, P. R. *Proc. Indian Acad. Sci. A*, 14, *pp.* 377–385, *Oct.*, 1941.—On the Raman idea of quantum exchanges of energy and momentum between a crystal lattice and an X-ray photon traversing it, the dynamic structure amplitudes of the various crystal planes of diamond are worked out, assuming that each Planck oscillator takes up 1 quantum of infra-red vibrational energy from the incident X-rays. Such an interaction gives rise to X-ray reflections of altered frequency in most cases. The structure amplitude of the (111) planes for this reflection is about 7% of that of the same planes for the Bragg reflection. The (222) planes, the (200) planes and the (662) planes, are found to possess finite structure amplitudes for the quantum reflections. It is suggested that the "forbidden" reflections in diamond are pure Raman reflections of modified frequency.

795 537.531 : 535.3 : 548.73

Low-temperature studies of the Raman X-ray reflections in crystals. VENKATESWARAN, C. S. *Proc. Indian Acad. Sci. A*, 14, *pp.* 387–394, *Oct.*, 1941.—The Raman reflections of X-rays by carborundum, rock-salt, sodium nitrate and penta-erythritol, are obtained at liquid-air temperature with a specially designed vacuum X-ray camera, and their intensities are compared with those at room temperature. For rock-salt an intermediate temperature of solid CO_2 and for carborundum two higher temperatures have also been employed. From the relative intensities of these reflections at various temperatures the infra-red frequency active in the particular reflection is ascertained in each case. This new X-ray effect provides a novel method of evaluating the infra-red frequencies of crystals.

796 537.531 : 535.3 : 548.73

The quantum reflection and the quantum scattering of X-rays in rock-salt. VENKATESWARAN, C. S. *Proc. Indian Acad. Sci. A*, 14, *pp.* 395–401, *Oct.*, 1941.—The "diffuse maxima" in the Laue patterns of rock-salt are obtained for 2 different crystal thicknesses and 2 different sizes of the pin-holes in the lead slit. A comparison of their intensity with the weak Laue spots in the same pattern does not show any appreciable change due to the increase of the volume of the crystal. The increase of the dia. of the pin-hole and the divergence of the X-ray beam has the same effect on the shape and dimensions of the Laue spots and of the diffuse max. A microphotometric study of the intensity distribution of the 1st-, 2nd- and 3rd-order spots due to the (200) planes of rock-salt reveals that they are much sharper and that the fall of intensity for increased angles of reflection is much less rapid than is to be expected if they were due to the scattering of X-rays by the thermally excited elastic waves in the crystal. It is concluded that these diffuse max. are due to Raman reflections of the X-rays.

797 537.531 : 535.3 : 548.73

The Raman X-ray reflections in organic crystals: I. Naphthalene. II. Benzophenone. III. Hexamethyltetramine. VENKATESWARAN, C. S. **IV. Benzil.** SUBRAHMANIAN, R. V. *Proc. Indian Acad. Sci. A*, 14, *pp.* 402–420 *and* 445–449, *Oct.*, 1941.—The Raman X-ray reflections from a naphthalene crystal are obtained. The experimental results are explained assuming the basic idea in the quantum theory of X-ray reflection in crystals [Abstr. 793 (1942)]. A study of the relative intensities of the dynamic re-

flections from the different crystal planes clearly demonstrates that the character of these reflections is determined by the geometry and amplitude of the lattice vibrations. The intensity of the reflection from 002 plane is enormously great. Other planes on either side of the latter, making angles of 0°–40°, also give rise to Raman spots of fair intensity. On the other hand, such reflections from planes making an angle of nearly 90° with the 001 plane are comparatively weak, in spite of the fact that they give very intense Bragg reflections. The difference in the behaviour of these reflections for naphthalene and benzophenone is due to the fact that, while in the former the plane of the molecule is normal to the 001 plane, in the latter it is parallel to the 001 plane. The X-ray reflections from the (110), (200), (211) and (111) planes show that the intensities of the dynamic reflections follow the same order as the intensities of the corresponding static reflections. The Raman spots of the crystal are relatively sharp compared with those from organic and inorganic crystals of complicated structure. These observations are explained by the fact that the molecular and the crystal structures of the substance have a high order of symmetry, and that, for the principal planes, there is only 1 Raman X-ray active lattice vibration which corresponds to a movement of the 2 molecules against each other along the cube diagonal. The geometry and orientation of the spots depend on the direction of the phase waves connected with the above vibration. In a series of well exposed Laue diagrams of benzil taken with a pencil of Cu X-radiation along the trigonal axis, 3 alternate planes are found to give intense Raman reflections, the alternate planes of the same form being much less active in this respect. A similar feature is also observed in photographs taken with the beam transverse to the trigonal axis. The facts find a very simple explanation when it is assumed that the 3 molecules of benzil in the unit cell, lying in equivalent positions along the 3-fold screw axis, have the planes of their aromatic rings practically coinciding with the planes mentioned. The inclination of 14° of the aromatic planes is in agreement with the angle of 13° deduced from the diamagnetic susceptibilities of the crystal. The X-ray method gives both the azimuth and orientation of the aromatic rings.

798 537.531 : 535.3 : 548.73

The lattice spectrum and the Raman X-ray reflections by rock-salt. VENKATESWARAN, C. S. *Proc. Indian Acad. Sci. A*, 14, *pp.* 426–433, *Oct.*, 1941.—The lattice vibrations of rock-salt are analysed and the intensities of the first and second orders of the Raman X-ray reflections from the (111), (100) and (110) planes are calculated for the 3 principal modes of vibration. The drift of the Raman spot for 400 and 620 [Abstr. 1400 (1941)] for 600, 620 and 420 planes for different crystal orientations is satisfactorily explained on the assumption that the phase waves are parallel to {311} planes of the crystal. The streamers that are observed in association with the max. in rock-salt are also explained on the basis of the co-existence of at least 3 such waves effectively connected with any particular plane.

799 537.531 : 535.3 : 548.73

On the multiple spots and streamers exhibited by the (111) dynamic reflections in diamond. PISHAROTY, P. R., AND SUBRAHMANIAN, R. V. *Proc. Indian Acad. Sci. A*, 14, *pp.* 439–444, *Oct.*, 1941.—The existence of 3 sets of phase waves of the lattice oscillations in diamond is shown to give rise to 3 quantum or Raman reflections from the (111) planes. Two of these reflections form very elongated spots which appear as streamers, due to the divergence of the beam and the obliquity of the corresponding reciprocal phase vectors, when the glancing angle of incidence θ is smaller than the Bragg angle θ_B. These reflections appear as discrete subsidiary spots when $\theta > \theta_B$. The behaviour of these reflections, with respect to intensity and orientation, when the plane of incidence of the classical reflection is (1) parallel to, and (2) inclined to, a (110) symmetry plane of the crystal, is described and accounted for.

800 537.531 : 535.3 : 548.73

Quantum reflection of X-rays in calcite. NILAKANTAN, P., AND NAYOR, P. G. N. *Proc. Indian Acad. Sci. A*, 14, *pp.* 450–458, *Oct.*, 1941.—The paper presents the results of a preliminary study of the X-ray reflections of the second kind observed in calcite. Numerous planes in this crystal exhibit such reflections, the dynamic spacings in most cases varying but little with the setting of the crystal. Observations are recorded concerning the sharpness of the reflections, their intensity and the influence of temperature on the same. The results are considered in the light of the quantum theory of X-ray reflection.

801 537.531 : 537.533 = 3

The yield of the change of cathode-ray energy into X-ray energy, and the energy loss of radium by the RaC γ-radiation. FERRANT, W. *Z. Phys.*, 115, 11–12, *pp.* 747–755, 1940.—Starting from Glocker's fundamental law, the relation is derived correlating the X-ray doses measured in Röntgen units with the energy of X-radiation passing per sec. per cm.^{2} On this basis the yield is determined for the exchange of cathode-ray energy into X-ray energy. The results agree reasonably well with the theory of the deceleration of the electron by radiation. This relation applied to measurements of the RaC γ-radiation leads to a value for the energy given off by the Ra. The method applies to very weak radiators. O. O.

See Abstr. 843 537.531 : 539.16.08

802 537.531.8

The average energy required to produce an ion pair in xenon with 0·16 Å X-rays. WALBRIDGE, N. L.

Phys. Rev., 60, *pp.* 852–856, *Dec.* 15, 1941.—Two measurements of the power were made; one with a lead-disc thermopile which absorbed 97% of the incident radiation and the other with a thin silver-disc thermopile which absorbed 8·9%. The ionization measurements were made with a glass ionization chamber which was filled with xenon at a pressure of 2·22 atm. This chamber absorbed 15·9% of the incident radiation. The value was found to be $21{\cdot}3 \pm 0{\cdot}8$ eV.

803 537.533 = 3

On energy exchange within a solid body. MÖGLICH, F., AND ROMPE, R. *Z. Phys.*, 115, 11–12, *pp.* 707–728, 1940.—The electron gas of a crystal and the crystal grating itself are mutually coupled. Hence, energy may be exchanged between the electron gas and the grating. In addition to the simple collisions between electrons and grating, considered by Bloch, multiple collisions occur, which are responsible for large exchanges of energy. This applies in particular at high temperatures. The temperature dependence of the effective cross-section is given. Finally, it is shown how equilibrium is established between very fast electrons and the electron gas within the crystal.

O. O.

See Abstr. 801 537.533 : 537.531

804 537.533.72 : 621.385.833

A magnetic field free from spherical aberration. GLASER, W. *Z. Phys.*, 116, 1–2, *pp.* 19–33, 1940.—[Abstr. 448 B (1942)].

805 537.533.75 = 3

Z-dependence of the bremsstrahlung of fast electrons. STAHEL, E., AND MASSA, J. *Helv. Phys. Acta*, 14, 5–6, *pp.* 325–326, 1941.

806 537.533.79 = 3

On assumptions concerning the interaction of electrons and heavy particles. FIERZ, M. *Helv. Phys. Acta*, 14, 5–6, *p.* 321, 1941.

807 537.533.8 = 3

A new method for measuring the energy distribution of secondary electrons. KOLLATH, R. *Z. techn. Phys.*, 21, 12, *pp.* 328–331, 1940.—[Abstr. 2181 (1941)].

808 537.533.8 = 3

Positron generation by β-rays. BRADT, H., AND SCHERRER, P. *Helv. Phys. Acta*, 14, 5–6, *pp.* 319–320, 1941.

809 537.534.74

An investigation of the scattering of positive alkali ions at an angle of 90° in mercury vapour. MACELWANE, J. B. *Phys. Rev.*, 60, *pp.* 762–765, *Dec.* 1, 1941.—The present work is a study of the behaviour of K, Rb and Cs ions, emitted from a solid block of Kunsman catalyst, scattered at an angle of 90° in Hg vapour and collected on a stationary cylinder. The values of the incident and scattered currents were measured simultaneously. The incident beam used was of the order of several times 10^{-9} A, while the scattered beam was of the order of 10^{-4} to 10^{-3} part of that value. Scattering was found to increase linearly with the pressure of the scattering vapour, to decrease with increasing energy of the incident ions for all ions studied, and to decrease with the mass of the incident ions.

810 537.534.74

On nuclear scattering. KAR, K. C. *Indian J. Phys.*, 15, *pp.* 113–122, *April*, 1941.—The formula for the intensity of proton-proton scattering given previously [Abstr. 1652 (1940)] is shown to be in better agreement with the second and improved experiment of Heydenburg, Tuve and Hafstad [Abstr. 545 (1940)]. The formula was derived assuming the existence of a short-range attractive force of neutron-proton type in addition to the Coulomb force of repulsion. The corresponding formula for the deuteron-deuteron scattering is deduced in the present paper assuming a short-range repulsive force of the same type; and it is found to be in good agreement with the observations of Heydenburg and Roberts [Abstr. 546 (1940)]. Again, assuming a short-range attractive force and neglecting the effect of exchange, a formula is derived for the intensity of scattering of deuterons by He. The agreement with the experiment of Heydenburg and Roberts is fairly satisfactory. It is also shown that the correction for the relative motion of the scattering particle is not negligible in case of deuteron scattering by He but may be neglected even at large angles in the case of protons. It is in agreement with the above experiment.

811 537.534.8

Range and ionization measurements on high-speed protons. WILSON, R. R. *Phys. Rev.*, 60, *pp.* 749–753, *Dec.* 1, 1941.—The rel. sp. ionization along an initially mono-energetic 4 eMV proton beam has been measured. The stopping power of Al rel. to air is found to be 1·48 mg./cm.^{2}/cm. of air at 15°C. and 76 cm. Hg, and is also found to be independent of the energy in the interval from 1·5 eMV to 4·0 eMV. That this should be so is adequately explained in the interpretation by Wheeler. The stopping power of a variety of metal foils was also measured and the results are given. From the above measurements it is possible to calculate I, the mean excitation energy of atoms with many electrons (a const. which enters into Bethe's formula for the fate of loss of energy of heavy particles due to ionization) to be $0{\cdot}85\ Z(me^4/2h)$ or $11{\cdot}5\ Z$ in eV.

812 537.591

The use of photographic plates as an aid to cosmic-ray investigations. BOSE, D. M. *Indian J. Phys.*, 15, *pp.* 145–160, *April*, 1941.

813 537.591.15 : 539.172

The observation of showers produced in air and nuclear disintegrations caused by cosmic rays in the

ionization chamber. EULER, H. *Z. Phys.*, 116, 1–2, *pp.* 73–104, 1940.—The theory of extended showers produced in air is compared with the observation of bursts in a non-covered ionization chamber (zero effect). The results are as follows: The larger bursts of the zero effect are quantitatively explained as the effect of air-showers if, in the spectrum of the primary electrons in the cosmos, one assumes a probability $H(E)$ of the electrons with an energy exceeding the value E, $H(E) = H_1(10^8 \text{ eV})^\gamma$ for $10^9 \text{ eV} < E < 10^{16}$ eV, $\gamma = 1{\cdot}8 \pm 0{\cdot}17$, $H_1 = 10^4/\text{min.cm.}^2$. The smaller bursts of the zero effect cannot reliably be interpreted as effects of air-showers. An argument is given that these smaller bursts represent nuclear disintegrations by cosmic rays, the same applies to the rays emanating from the walls of an ionization chamber. The results of experiments with 2 ionization chambers are computed on this basis. The rare occurrence of air-showers gives a new argument for the statement that most of the electrons observed at sea level are produced, not by cascade effects of the electrons of the cosmos, but by secondary processes of the hard rays. O. O.

814 537.591.3 = 3

The absorption curve of cosmic radiation in Pb under a water-equivalent of 1 000 m. BARNÓTHY, J., AND FORRO, M. *Z. techn. Phys.*, 21, 12, *pp.* 290–291, 1940.—[Abstr. 2061 (1941)].

815 537.591.3

Mass of the meson by the method of momentum loss. WHEELER, J. A., AND LADENBURG, R. *Phys. Rev.*, 60, *pp.* 754–761, *Dec.* 1, 1941.—Observations on the curvature of the track of a meson before and after traversal of a known amount of matter allow a determination of the mass of the particle. A discussion is presented of the accuracy and advantages of this method of measuring mass. The stopping power for fast particles was computed on the basis of experiments reported [Abstr. 811 (1942)]. Discussion of the formula is contained in the appendix. Curves are presented for the dependence of range on energy and momentum for swift H and He nuclei as well as for mesons. The method of momentum loss is illustrated and values are obtained for the mass of the meson. The evidence shows the necessity for more mass determinations before it can be decided whether there is a distribution of masses of the meson or not.

816 537.591.5

Differential measurements of the meson's lifetime at different elevations. BERNARDINI, G., CACCIAPUOTI, B. N., PANCINI, E., PICCIONI, O., AND WICK, G. C. *Phys. Rev.*, 60, *pp.* 910–911, *Dec.* 15, 1941.

817 537.591.8 = 3

The distribution of the secondaries produced by cosmic rays at the boundary air/lead. STEINKE, E. G., AND SCHMID, H. *Z. Phys.*, 115, 11–12, *pp.* 740–746, 1940.—With a thin-walled pressure ionization chamber and a tube electrometer the distribution of showers and the production curves for large showers (more than $0{\cdot}136 \times 10^6$ ion pairs) are observed with lead radiators between 0 and 20 cm. thick. The most probable occurrence is at 2·25 cm. lead, except for very large showers. This result seems to contradict the present interpretation which leads to a continuous shift of the max. A new interpretation is suggested introducing 2 separate effects (first max. by multiplication of the showers in air; second max. by the production of the showers). This interpretation is confirmed at the preliminary evaluation of measurements with Fe and Al radiators. O. O.

818 537.591.8 : 523.16

Electric fields in interstellar space. EVANS, F. *Phys. Rev.*, 60, *p.* 911, *Dec.* 15, 1941.

MAGNETISM. ELECTROMAGNETISM

819 538.12 : 539.154

Internal diamagnetic fields. LAMB, JR., W. E. *Phys. Rev.*, 60, *pp.* 817–819, *Dec.* 1, 1941.—In the precise molecular-beam experiments of Rabi and his collaborators, it is necessary to know the value at the nucleus of the magnetic field produced by the diamagnetism of the atomic electrons. This has been calculated on the basis of the Fermi–Thomas model, and checked for a number of atoms. The statistical treatment gives for ratio of induced to external field $0{\cdot}319 \times 10^{-4}Z^{4/3}$, while the numerical coeff. on the basis of the Hartree model is lower by 19% at $Z = 19$ and by 12% at $Z = 80$. The effect is equivalent to a reduction of the nuclear g value by a factor of $(1 - 0{\cdot}319 \times 10^{-4}Z^{4/3})$ and, in this form, the correction may be applied in the calculation of hyperfine structure of heavy atoms. The influence of the diamagnetic fields on an orbital electron has also been considered, and it is shown that it is equivalent to a reduction in the g value of an outer s electron by an amount of the same order of magnitude as the relativistic correction.

820 538.22

The mode of causation of thermo-remanent magnetism in igneous rocks. NAGATA, T. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 49–80, *March*, 1941.—By thermo-remanent magnetism is meant the magnetism that remains in a sample after cooling from temperature t to zero in a uniform magnetic field. An investigation was carried out on about 20 samples of igneous rocks. Each sample was powdered and contained in a silica tube set axially in a tubular electric furnace situated at the centre of a large Helmholtz coil. The results obtained are tabulated, graphed and discussed. A. W.

821 538.22

Variation of the magnetic properties of antimony with electron concentration. BROWNE, S. H., AND

LANE, C. T. *Phys. Rev.*, 60, *pp.* 895–899, *Dec.* 15, 1941.—The principal magnetic susceptibilities of single crystals of pure Sb and solid solution alloys of Sb with Sn, Ge, Pb and Te, have been determined. It is found that as the percentage of alloying metal increases the susceptibility perpendicular to the trigonal axis changes but little and remains diamagnetic. On the other hand, the susceptibility parallel to this axis decreases sharply in magnitude and, in the case of Sn and Ge, changes from diamagnetic to paramagnetic beyond 1·17 atom. % Sn and 1·25 atom. % Ge. This result permits calculating the number of electrons which overlap into the second Brillouin zone in Sb as 10^{-2} electron per atom. The bearing of these results on the current theory of metals is discussed.

822 538.22

Temperature variation of the magnetic susceptibilities of antimony–tin alloys. BROWNE, S. H., AND LANE, C. T. *Phys. Rev.*, 60, *pp.* 899–905, *Dec.* 15, 1941.—The principal magnetic susceptibilities of single crystals of pure Sb and of Sb–Sn alloys up to 4·1 atom. % Sn have been determined in the temperature range 77°K. to room temperature. The measurements were made with a modified ring balance. The diamagnetic suspectibility perpendicular to the trigonal axis is practically independent of temperature for all the alloys. The susceptibility parallel to this axis decreases in magnitude with increase in temperature, both for alloys in which it is diamagnetic and those in which it is paramagnetic, with one exception, the alloy of 1·06 atom. % Sn. A suitable correction for the temperature-independent diamagnetic susceptibility of the lattice ions brings this exception into agreement with the others. Values of the effective masses of the electrons, which occur as parameters in the energy equation, are computed, and the energy interval between the bottom of the second Brillouin zone and the top of the Fermi distribution is estimated as about 0·04 eV.

See Abstr. 933 538.22 : 550.3 : 551.2

823 538.221

Anisotropy of hysteresis in ferromagnetic single crystals. III. SHUR, J. S. *J. Phys., U.S.S.R.*, 4, 5, *pp.* 439–447, 1941.—The effect of treatment in a magnetic field in different crystallographic directions is investigated, and by using the results it is possible to produce material of such texture that after suitable heat treatment in a magnetic field the coercive force is reduced. The decrease that can be obtained is of the order of 20%. R. P.

824 538.23

Hysteresis torque in elliptically polarized fields. BECK, JR., F. J., AND CLARKE, J. G. *J. Appl. Phys.*, 12, *pp.* 860–866, *Dec.*, 1941.—Hysteresis is, in general, of 2 types: the usual alternating hysteresis, and the torque component of hysteresis which gives rise to rotational loss when the direction of the field intensity is changed and the magnitude is held fixed. By means of a torque magnetometer the time average of the torque was observed as a function of the applied field intensity for elliptical fields of different eccentricity. For the silicon iron disc investigated, and with the field along 1 axis (the first axis) as a parameter, the time average of the torque increases with applied field along the mutually perpendicular axis, reaching a max. at the bend in the magnetization curve, and then decreases as saturation is approached. The torque curves first increase, go through a limiting curve, and then decrease as the field along the first axis is increased. A qualitative explanation of the shape and variation of the torque curves with field strength is suggested.

825 538.242

On the gyromagnetic effects in ferromagnetic substances. GORTER, C. J. *Phys. Rev.*, 60, *p.* 836, *Dec.* 1, 1941.

826 538.248

Increase of residual magnetism caused by a current flowing through an iron bar. PERKINS, H. A., AND DOOLITTLE, H. D. *Phys. Rev.*, 60, *pp.* 811–817, *Dec.* 1, 1941.—If a bar of high-grade wrought iron or of permalloy is placed in a sufficiently strong magnetic field, and if this field is abruptly reduced to zero, a current set up in the iron causes an increase of the residual magnetism. This effect is not obtained when the field is gradually eliminated, nor is it obtained when the current flows in a wire along the axis of a bored-out iron cylinder unless the cylinder is slotted longitudinally. Then the increase of magnetism is again observed. There seem to be 2 effects involved; one results in decreasing the residual magnetism and is associated with the circular flux set up in the bar by a current sent directly through it or in a separate wire along its axis, the other, if it could be completely isolated, would probably produce only increases in residual magnetism, and seems to depend on an unstable condition of the magnet.

827 538.5

The origins and developments of the concepts of inductance, skin effect and proximity effect. HIGGINS, T. J. *Amer. J. Phys.*, 9, *pp.* 337–346, *Dec.*, 1941.

828 538.566.2

Propagation of electromagnetic waves in a space charge rotating in a magnetic field. BLEWETT, J. P., AND RAMO, S. *J. Appl. Phys.*, 12, *pp.* 856–859, *Dec.*, 1941.—A theoretical discussion of the transmission of electro-magnetic waves of the symmetrical, transverse magnetic type by a space charge of uniform density, rotating under the influence of a uniform magnetic field. The space charge presents to the wave an effective dielectric const. < 1. By appropriate choice of magnetic field the dielectric const. can be reduced to 0 and can even become negative, so

that the wave undergoes attenuation as it passes through the space charge. Experiments are described on the control of the propagation constants of 470 Mc./s. waves by variation of the dielectric const. of the medium. The results obtained are in agreement with the theoretical predictions.

See Abstr. 783 538.632 : 537.311

829 538.653.1 = 3

Studies on the influence of strains on coercive force and critical field strength of Barkhausen discontinuities. KERSTEN, M., AND GOTTSCHALT, P. *Z. techn. Phys.*, 21, 12, *pp.* 345–352, 1940.—A brief summary is given of more recent theories of ferromagnetic hysteresis and coercive force. Results are given on the effect of Heating and recrystallization upon coercivity and initial susceptibility of cold-worked bands of Ni, Fe and of Fe–Ni alloys. From these results are calculated the wavelength of the spatial fluctuation of the residual tensions arising from plastic deformation. The result is in good agreement with the dimensions of plastic-domain structure in crystals. On the basis of previous theoretical work the dimensions of Weiss domains may be estimated. G. H. D.

MOLECULAR AND ATOMIC PHYSICS

830 539.132

Computation of the diamagnetic anisotropy of non-cyclic molecules. NEUGEBAUER, T. *Z. Phys.*, 115, 11–12, *pp.* 678–695, 1940.—The diamagnetic anisotropy of saturated non-cyclic molecules can be interpreted on the basis of quantum mechanics. The computation is carried through for the HCl molecule. The results are easily generalized for more complicated molecules. From quantum mechanics it follows that the diamagnetic susceptibility of straight molecules is greater in the direction of their axes. The anisotropy of the nitrate and carbonate radicals and the significance of the paramagnetic polarization at h.f. for the case of the N_2 molecule are discussed. London's theory explains the greater diamagnetic anisotropy of aromatic molecules at which the directions of the max. susceptibility and the max. polarization are at rt. angles to each other. O. O.

831 539.132

The vibration-rotation energies of polyatomic molecules. NIELSEN, H. H. *Phys. Rev.*, 60, *pp.* 794–810, *Dec.* 1, 1941.—The quantum-mechanical Hamiltonian function, H, for the general vibrating-rotating polyatomic molecule of N atoms is expanded by the method of Wilson and Howard to second order of approximation. Solutions of the Schrödinger equation, $(H - E) = 0$, are obtained for asymmetric molecules, axially symmetric molecules and linear molecules. Expressions for the anharmonic terms occurring in the vibration energy, the effective moments of inertia, the amplitudes of the internal angular momentum of oscillation and the centrifugal distortion coefficients, are derived so that, when the normal co-ordinates are known, the vibration-rotation energies of a polyatomic molecule may be calculated from the results given. Tetrahedrally symmetric molecules and models in which internal rotation occurs are regarded as anomalous cases and are not treated.

See Abstr. 747 539.132 : 535.338

832 539.132 : 541.57

Quantum theory of the chemical bond. COULSON, C. A. *Proc. Roy. Soc. Edinb.*, 61, 2, *pp.* 115–139, 1941.—A review dealing with the molecular orbital approach to the quantum theory of the chemical bond. The single bond is discussed with reference to the H_2O and HCl molecules, and to the formation of the saturated C atom. In C_2H_4 a double-streamer orbit appears. In C_6H_6 there is a framework of single bonds, the remaining electrons embracing all 6 C atoms. It is shown how the theory explains the properties of aromatic compounds. The lengths of bonds calculated from the theory agree in general with experimental values. The importance of mobile electrons in a study of vibration frequencies, restricted rotation about C–C bonds, and in polymerization, is emphasized. A. J. M.

833 539.133

The magnitude of the solvent effect in dipole-moment measurements. IV. Determination of distortion polarization and its additivity in the alkyl and aryl halides. AUDSLEY, A., AND GOSS, F. R. *J. Chem. Soc.*, *pp.* 864–873, *Dec.*, 1941.—[See Abstr. 2687 (1940)].—By combining dielectric-polarization data for ethyl bromide in the liquid and the vapour state, some of the uncertainty concerning the magnitude of the atom polarization (P_A) can be eliminated. Methods for deciding the distribution of the polarization of binary liquid mixtures between their components are discussed, and the necessary data are presented to extend the above elimination method for the determination of the distortion polarization (P_{E+A}) to compounds of all 4 halogens. It is also found that the polarization of non-polar hydrocarbons and the values of P_{E+A} obtained by this elimination can, for certain halogen compounds, be expressed as the sum of contributory values assigned to each atom or bond. Values of P_{E+A} for C, H and all 4 halogens, in compounds of the type RX are calculated, and it is shown that, whereas the electron polarization (P_E) increases, P_A appears to exhibit a general tendency to decrease in ascending the series from F to I.

834 539.133

The relation between potential energy and interatomic distance in some diatomic molecules. II. LINNETT, J. W. *Trans. Faraday Soc.*, 38, *pp.* 1–9, *Jan.*, 1942.—Using the potential energy function $V = ar^{-m} - be^{-nr}$ together with expressions which enable the values of the constants, a, b, m and n, to be fixed, a relation

has been obtained with which a good estimate of r_e can be made from observed values of the vibration frequency. Approximate values of D and $\omega\chi$ can also be calculated. [See Abstr. 6 (1941)].

835 539.15

Self-consistent field, with exchange, for Si IV and Si V. HARTREE, W., HARTREE, D. R., AND MANNING, M. F. *Phys. Rev.*, 60, *pp.* 857–865, *Dec.* 15, 1941.—Results of solutions of Fock's equations for the normal state of Si V and for 3*s*, 4*s*, 5*s*, 3*p*, 4*p*, 5*p*, 3*d*, 4*d*, 5*d*, 4*f* and 5*g* states of Si IV are reported. Computed term values for the series electron are in satisfactory agreement with experimental values, although the agreement is no better than that obtained by McDougall. Spin-orbit separations have been calculated from these wave functions. The agreement with observed value is satisfactory for the *p* states but not for the *d* and *f* states.

836 539.152.1

The difficulty in the field theory of exchange forces. STÜCKELBERG, E. C. G. *Z. techn. Phys.*, 21, 12, *p.* 275, 1940.—[See Abstr. 187 (1941)].—Ordinary forces may be obtained by introducing the analogue of Maxwellian sources, dependent only on the position of the field particle, but the source must also be dependent on charge and invariable if exchange forces are required. The latter assumption leads to 3-body and 4-body nuclear forces, as well as the simpler 2-body forces. Serious divergence of the 3-body forces can only be avoided by a relativistically non-invariant cut-off. Further, the spin-orbit coupling associated with the quadruple moment of the deuteron must be eliminated if the 3-body forces are to be weaker than the 2-body forces. G. H. D.

837 539.152.1

Meson theory and nuclear forces. WERGELAND, H. *Phys. Rev.*, 60, *pp.* 835–836, *Dec.* 1, 1941.

838 539.153

The excitation of crystal phosphors by corpuscular rays. MÖGLICH, F., AND ROMPE, R. *Z. techn. Phys.*, 21, 12, *pp.* 304–307, 1940.—The theory of Riehl and Schön for the mechanism of light excitation in crystal phosphors is applied to the case when the phosphor is excited by electrons and heavier particles. The primary process is in each case the excitation of an electron into the upper band. This electron interacts with the other electrons in this band (the electron gas), analogous to the mechanism in a plasma gas discharge. Only when the excited electron has lost practically all its kinetic energy is it ready to go down to a lower band and cause light emission. Whereas the yield for the re-emission is very high (up to 95%) for the excitation by photons and heavy particles, it is quite low (5–10%) for the excitation by fast electrons. This is explained by the fact that the energy of the electrons excited by the impact of fast electrons is quite high, and they produce a cascade of secondary electrons of progressively decreasing energy. The lifetime of the fast electrons is therefore considerably longer and there is time for interaction with the crystal lattice by which a large part of the excitation energy is lost as heat energy of the lattice. [See Abstr. 1397 (1941)]. G. H. D.

See Abstr. 819 539.154 : 538.12

839 539.16.08 = 3

Measurements on long-range proton beam. JENTSCHKE, W. *Z. techn. Phys.*, 21, 12, *pp.* 276–280, 1940.—Careful measurements on the intensity of ionization of protons as a function of residual range have previously been carried out only up to a range of about 6 cm., and the energy/range relation for protons up to about 2×10^6 V. The work here reported carries the experimental ionization/range relation up to 70 cm. Energetic protons obtained by radiating B with the α's from Po were used. Protons are passed first through a deep ionization chamber and then through a shallow ionization chamber, separated from the former by a thin Al foil. Each chamber acts as a proportional counter, and the size of each pulse is recorded when coincidences occur. The largest pulses in the shallow chamber correspond to protons which barely traverse both chambers. By comparing measurements taken at various pressures, the relation of ionization intensity to residual range is deduced. Comparison with the energy/range relation showed that the energy loss is $\propto$ intensity of ionization in the range between 6 and 70 cm. The weak, long-range group of α-particles from the reaction investigated is found to have a range of 94 cm. [See Abstr. 2177 (1941)]. G. H. D.

840 539.16.08

Optimum liquid combinations for cloud chambers. BECK, C. *Rev. Sci. Instrum.*, 12, *pp.* 602–606, *Dec.*, 1941.—A search was made for liquid mixtures giving low expansion ratio, low background fog and good electron tracks, in cloud chambers filled with air at near atm. pressure. Mixtures of any lower alcohol with water gave a min. in the curve of expansion ratio *v.* conc., while no min. was found in the curve for mixtures of any 2 alcohols. The optimum mixture was 50% ethyl or normal propyl alcohol, 25% water, and 25% acetone; the presence of acetone increases the contrast between tracks and background fog. A brief study of photochemical fog, with a quartz mercury arc, showed that wavelengths below 3 900 Å are chiefly responsible for such fog. Irradiation of pure alcohols gives no perceptible fog, but irradiation of the optimum mixture above produces dense fog. However, the clean-up after irradiation is sufficiently rapid to offset the disadvantage of its sensitivity to light.

841 539.16.08

Nuclear spectra of light elements on the photographic plate. MEERHAUT, O. *Z. techn. Phys.*, 21,

12, *pp.* 280–284, 1940.—A critical review is given of applications of the photographic method by various authors to determine the energy spectra of reactions involving light nuclei. Apparatus used by the author to observe energetic protons leaving at rt. angles to the path of the incident α-particles [Abstr. 2094 (1940)] is described. The protons enter the emulsion at such a small angle that they can travel a distance equivalent to 75 cm. of air in it. The reaction Al^{27} (α, *p*) Si^{30} leads to 3 proton groups at sufficiently high α-energy, to 2 proton groups at lower bombarding energies. The reactions Na^{23}(α, *p*) Mg^{26} and P^{31} (α, *p*) S^{34} each show 2 proton groups. The $\frac{1}{2}$ width of the long-range group in each case corresponds to a range of about 10 cm., or about $\frac{1}{4}$ of the range of the group. Two groups were also noted in the reaction B^{10} (α, *p*) C^{13} when observed at rt. angles, although they could not be observed in the forward proton.

G. H. D

842 539.16.08

Range/velocity relation for fission fragments in helium. Bøggild, J. K. *Phys. Rev.*, 60, *pp.* 827–830, *Dec.* 1, 1941.—The range/velocity relation of fission fragment tracks in He was studied by means of individual close collisions as well as by statistical considerations of the branch frequency. The comparison with previous investigations of fragment tracks in A indicates that the shape of the range/velocity curves for the two gases differs appreciably in the last part of the range, as was to be expected from theoretical considerations concerning the relative contributions to the stopping power by electron encounters and nuclear collisions in light and heavy gases.

843 539.16.08 : 537.531

A comparison between a Geiger–Müller counter, a secondary-electron multiplier tube, and photographic film for detecting weak X-rays. Eisenstein, A., and Gingrich, N. S. *Rev. Sci. Instrum.*, 12, *pp.* 582–586, *Dec.*, 1941.—A comparison has been made between 3 methods, given in the title, for the detection of weak X-rays. The secondary-electron multiplier tube has a lower resolving time than the Geiger–Müller tube, but the G–M tube is from 5 to 10 times as sensitive to X-rays of the wavelengths here studied, 0·63Å to 1·54Å. A diffraction pattern of a liquid can be obtained with a G–M counter in roughly $\frac{1}{20}$ the time taken for a photographic exposure.

844 539.162

Radioactive isotopes of cobalt. Livingood, J. J., and Seaborg, G. T. *Phys. Rev.*, 60, *p.* 913, *Dec.* 15, 1941.

845 539.164.84 = 3

The excitation function of the γ-radiation which is excited by bombarding Be^9, $B^{10, 11}$, and Al^{27} with Po-α-particles. Szalay, A., and Zimonyi, J. *Z. Phys.*, 115, 11–12, *pp.* 639–650, 1940.—The experimental arrangement had a very high resolving power which was reached by placing a Po radiator of only 3 mm. dia. in the centre of a hemisphere of 50 mm. dia. The fine structure so observed and the accurate limits of the excitation functions permit conclusions regarding the excited nuclear states. O. O.

846 539.165.8

On the pseudo-scalar mesotron theory of β-decay. Nelson, E. C. *Phys. Rev.*, 60, *pp.* 830–833, *Dec.* 1, 1941.—The calculations of Sakata which indicate that the pseudo-scalar mesotron theory can successfully account for both mesotron decay and β-decay are shown to be in error. While the pseudo-scalar mesotron theory gives the correct spin and parity selection rules for β-decay, it also gives β-decay lifetimes too long by a factor of 10^6 and having an inverse 7th-power dependence on the upper limit of the β-spectrum. As these same conclusions can be made when the mesotron field is strongly coupled to nuclear particles, it would seem that they are sufficient to show that pseudo-scalar mesotrons are not responsible for β-decay.

847 539.166.1 = 3

Experiments to determine a new high-energy γ-ray component of RaC. Stahel, E., and Walton, J. *Helv. Phys. Acta*, 14, 5–6, *pp.* 326–327, 1941.

848 539.166.831 = 3

The energy distribution of photo-electrons before their liberation from the metal. Mayer, H. *Z. Phys.*, 115, 11–12, *pp.* 729–739, 1940.—A method is discussed for the experimental determination of the component of the energy of photo-electrons normal to the surface. The shape and transmission of the potential barrier at the metal surface is discussed.

O. O.

849 539.166.831

Nuclear photo-effect on sulphur, aluminium, and magnesium. Huber, O., Lienhard, O., Scherrer, P., and Wäffler, H. *Phys. Rev.*, 60, *p.* 910, *Dec.* 15, 1941.

850 539.166.93 : 621.384.2

Applications of radioactive tracers to biology and medicine. Hamilton, J. G. *J. Appl. Phys.*, 12, *pp.* 440–460, *June*, 1941.—[Abstr. 436 B (1942)].

See Abstr. 813 539.172 : 537.591.15

851 539.172.4 = 3

Nuclear reactions of fluorine with fast neutrons. Huber, P., Rossel, J., and Scherrer, P. *Helv. Phys. Acta*, 14, 4–5, *pp.* 314–316, 1941.

852 539.172.4

Preparation and properties of long-lived radiochlorine. Grahame, D. C., and Walke, H. J. *Phys. Rev.*, 60, *p.* 909., *Dec.* 15, 1941.

853 539.185.7

Slowing-down of low-energy neutrons in water. Goldhaber, M., and O'Neal, R. D. *Phys. Rev.*, 60, *p.* 834, *Dec.* 1, 1941.

854 539.185.9

Scattering of neutrons in deuterium. SUNDARACHAR, C. K., AND STREIB, J. F. *Nature, Lond.*, 149, *p.* 51, *Jan.* 10, 1942.

855 539.211 = 3

On the propagation of shattering in glass and in glass substitutes. SCHARDIN, H., ELLE, D., AND STRUTH, W. *Z. techn. Phys.*, 21, 12, *pp.* 393–400, 1940.—The development of spark cinematography has made possible the study of the propagation of shattering processes in transparent bodies. Shots are fired obliquely through the glass or perpendicularly to an edge. The results agree in all respects with those by Barstow and Edgerton (*J. Amer. Ceram. Soc.*, 22, *p.* 302, 1939] obtained by striking the glass with a body having a low velocity. Elastic strain developed by the shots is studied by means of polarized light and colour photography. With both oblique and edgewise shots, longitudinal waves of velocity 5 400 m./sec. are present, accompanied by the shattering process travelling at 1 500 m./sec. Secondary shattering occurs as the result of co-operation of longitudinal and transverse waves and the existence of some irregularity initiating a break before the arrival of primary shattering. Such secondary shattering occurs especially at the edges of plates, at the location of wires in wire-embedded glass, or at natural or artificial interruptions of the glass surface. Shatter velocity along lines ruled with diamond is about double that of the normal. This is easily explained as a continuous co-operation of primary and secondary processes. Numerous photographs show many stages of shattering in glass, safety glass, and plexiglass. G. H. D.

856 539.217

Soil morphology and soil physics. NIKIFOROFF, C. C. *Amer. J. Phys.*, 9, *pp.* 346–356, *Dec.*, 1941.

857 539.217

Water absorption of resins. IRANY, E. P. *Industr. Engng Chem.*, 33, *pp.* 1551–1554, *Dec.*, 1941.—For the quantitative study of water absorption it is necessary to observe the whole course of absorption-time functions under isothermal conditions. Homogeneous resinous substances absorb water by diffusion, in good accord with a theoretically deduced law. The latter specifies 2 independent material factors, P, the rate of penetration or permeability, and S, the saturation limit under given conditions. Both constants are required for adequate description of the material. In the presence of dispersed granular or fibrous fillers, capillary action predominates. Water-attracting or binding agents, e.g. hydrophylic chemical groups on the resin molecule or impurities such as soluble salts, cause characteristic deviations from the fundamental régimes.

See Abstr. 752 539.23 : 535.342

858 539.26

X-ray study of the elastic constants of metals. LONSDALE, K., AND SMITH, H. *Nature, Lond.*, 149, *pp.* 21–22, *Jan.* 3, 1942.

859 539.31

Solution of problems of elasticity by the framework method. HRENNIKOFF, A. *J. Appl. Mech.*, 8, *A*169–*A*175, *Dec.*, 1941.—To avoid mathematical difficulties the author adopts the method of replacing the continuous material of the elastic body by a framework of bars arranged according to a definite pattern, the elements of which are endowed with elastic properties suitable to the type of problem. Analysis of the framework follows for various types of problem, and examples of the application of the principles involved are also given. Although the method is not exact, and is quite laborious, it permits solution of a number of problems in which formal mathematics fail. G. E. A.

860 539.319 : 621.317.39

How to avoid overstress in machine parts. HIVELY, M. W. *Gen. Elect. Rev.*, 44, *pp.* 621–623, *Nov.*, 1941.—[Abstr. 411 B (1942)].

See Abstr. 717 539.32 : 534.1

See Abstr. 904 539.32 : 548

See Abstr. 758 539.37 : 535.43

861 539.382.2 : 621.317.39

A new lateral extensometer. FOREST, A. V. DE, AND ANDERSON, A. R. *J. Appl. Mech.*, 8, *A*152–*A*154, *Dec.*, 1941.—[Abstr. 412 B (1942)].

862 539.384.4

Lateral buckling of I-section column with eccentric end loads in plane of the web. JOHNSTON, B. *J. Appl. Mech.*, 8, *A*176–*A*180, *Dec.*, 1941.—When a relatively slender column of the symmetrical I or WF shape is loaded eccentrically in the plane of the web by longitudinal end loads it may fail by elastic instability involving a combination of lateral bending and twisting. The solution for the WF or I-column shows that relatively small eccentricities of the longitudinal end load applied in the plane of the web cause a large falling off from the Euler critical load. For the ideally straight column, with a material perfectly elastic up to the yield point, there would be a critical $1/r$ ratio for any given eccentricity, column length, and material. Below this critical ratio the column would fail by yielding, according to the secant or eccentricity formula. Above the critical ratio the failure would be by elastic instability with respect to lateral bending and twisting. Application of the equations is made to 2 structural wide-flange sections, of light and medium weight, and the results are presented in the form of diagrams.

863 539.385

An extension of the sand-heap analogy in plastic torsion applicable to cross-sections having one or more

holes. SADOWSKY, M. A. *J. Appl. Mech.*, 8, *A*166–*A*168, *Dec.*, 1941.—The basic theory of the sand-heap method of plasticity as developed by Nádai, which involves determination of the twisting moment in plastic torsion by means of the formula $2(k/m)V$, is quoted. The author explains the principles upon which the analogy is modified to apply in the case of cross-sections having one or more holes, such as a twisted shaft. The technique developed to meet such cases is described in detail and a mathematical analysis is given which results in a twisting-moment formula for a cross-section with holes, equivalent in accuracy to that of the original equation for the simple case of a twisted bar.

864 539.4.01 = 3

The theory of rigidity for a varying load. DEHLINGER, U. *Z. Phys.*, 115, 11–12, *pp.* 625–638, 1940.—Deals with the difference between mono-crystal and polycrystal, the physical nature of the limit of rigidity for a varying load, and the mechanism of braking. O. O.

865 539.4.013.3 : 539.52

The technical cohesive strength of metals. MCADAM, JR., D. J. *J. Appl. Mech.*, 8, *A*155–*A*165, *Dec.*, 1941.—A survey is made of the literature dealing with the cohesive strength of metals, e.g. in a tensile test the cohesive strength would be the breaking load divided by the sectional area at fracture. Kuntze developed a method of using notched specimens to find the technical cohesion limit by determining the stress necessary to fracture specimens having various ratios of area at root of the notch to full sectional area, the actual limit being obtained by extrapolation. Ductility, as represented by reduction of area, decreases with increase of notch depth to a min. when the above-mentioned ratio is 0·5, after which it rises again. The larger the dia. of the specimen, the smaller the effect of the notch depth on the ductility. The influence of plastic deformation on the technical cohesive strength of ductile steel and Al is studied, together with the effect of combinations of principal stresses on the cohesion limit. A. C. W.

866 539.4.016

Stresses in drill steel. COOPER, L. O. *Engng J. Can.*, 24, *pp.* 534–535, *Nov.*, 1941.—The magnitude of stresses occurring in a length of rock drill steel during the drilling process is investigated mathematically. The max. stress curve shows that failure from fatigue should occur near the bit or shank end. In actual drilling breaks would probably occur close to the shank end. The stress equations show that the stresses depend mostly on the velocity with which the rod is struck. J. S. G. T.

867 539.4.016

Impact strength of copper. COOK, M., AND LARKE, E. C. *J. Inst. Met.*, 68, *pp.* 1–14, *Jan.*, 1942.—A study of de-oxidized arsenical and non-arsenical, and tough-pitch arsenical and non-arsenical coppers, in the form of extruded rod and rolled plate. The effect of cold work on the Izod values of both plate and rod was investitated, and, on the former, tests were carried out on specimens cut parallel and transversely to the direction of rolling. The presence of arsenic in the amounts added to produce arsenical copper does not appreciably affect the impact strength of tough-pitch or de-oxidized copper rod or plate. Both de-oxidized arsenical and non-arsenical coppers have higher impact values than the corresponding varieties of tough-pitch copper. The effects of grain size and temperature on impact strength have been investigated.

868 539.411

Psycho-physical significance of the dissipation coefficient of soft materials. BLAIR, G. W. S., AND COPPEN, F. M. V. *Nature, Lond.*, 149, *pp.* 22–23, *Jan.* 3, 1942.

869 539.434 : 548

Theory of the plastic properties of solids. III. SEITZ, F., AND READ, T. A. *J. Appl. Phys.*, 12, *pp.* 470–486, *June*, 1941.—[See Abstr. 1958 (1941)]. The present paper deals with the creep of single crystals, and it is considered that creep and slip are not very different. The term "creep rate" is defined, and 2 creep rates are distinguished—the transient and the steady-state rates. The former is found to be much less sensitive to temperature effects than the latter. The theory of dislocations, which was described in one of the earlier papers, is applied to the creep problem. The view is expressed that the mechanisms responsible for internal friction and for α-creep are probably different. Tests made on single crystals of Al, α-brass and Zn, show that discontinuities occur which decrease in size with decreasing temperature and increase in frequency with increasing temperature, and the tests prove that the effect is associated with slip and not with twinning. Twinning and rupture are briefly dealt with. A. C. W.

See Abstr. 865 539.52 : 539.4.013.3

870 539.53 = 3

Investigations on phenomena occurring with the wear of hard metal tools. DAWIHL, W. *Z. techn. Phys.*, 21, 12, *pp.* 336–345, 1940.—Characteristics like deformation, hardness and its temperature dependence, of hard metal (cemented tungsten carbide) were determined and compared with the same quantities for steel alloys. Thus a physical basis is established for the superiority of hard metal over steel for various tools. With a Co content of 5% the alloy will withstand a pressure up to 400 kg./mm.^{2} without lasting deformation. This value decreases with increasing Co content. The resistance to stretching and bending is also greatest for the lower Co content and considerably higher than for steel. In grinding a deformation of the crystal lattice takes place to a depth of about 0·01 mm., which is about 1/10 to 1/25 of the thickness

of the layer in steel which is deformed in the same grinding process. The hardness of tungsten carbide with 5% Co is about 50% higher than that of hardened alloy steel. It also decreases with increasing Co content and is about equal to that of steel for 20% Co. Up to 700°C. the hardness of the alloy with 5% Co decreases linearly from 1 750 kg./mm.^{2} at room temperature to 1 053 kg./mm. at 700° C. For steel there is a much more rapid decrease above 500°. The superiority of the alloys with a small amount of Co is explained by the fact that the individual tungsten carbide crystals are not completely separated by the embedding Co and that the tungsten carbide frame itself has a high rigidity when all the Co is removed. At high temperatures, i.e. at high operating speeds, there occurs a welding of parts of the worked material to the cutting-tool surface which increases the wear. This can be decreased by adding titanium carbide to the alloy (about 15% TiC). G. H. D.

871 539.62 : 621.89

The influence of surface films on the dry and lubricated sliding of metals. HUGHES, T. P., AND WHITTINGHAM, G. *Trans. Faraday Soc.*, 38, *pp.* 9–27, *Jan.*, 1942.

PHYSICAL CHEMISTRY

872 541.115

Free energies and equilibria of isomerization of the butanes, pentanes, hexanes and heptanes. ROSSINI, F. D., PROSEN, E. J. R., AND PITZER, K. S. *J. Res. Nat. Bur. Stand., Wash.*, 27, *pp.* 529–541, *Dec.*, 1941.

873 541.115

Heats of isomerization of the 9 heptanes. PROSEN, E. J. R., AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 27, *pp.* 519–528, *Dec.*, 1941.—The heats of isomerization of all of the 9 heptanes except 2-methylhexane and 3-methylhexane were determined by measurement of the ratios of their heats of combustion in the liquid state, using the procedure previously described for the hexanes. Values for 2-methylhexane and 3-methylhexane were calculated from the corresponding experimental values for the isomerization of *n*-hexane into 2-methylpentane and 3-methylpentane and of *n*-octane into 2-methylheptane and 3-methylheptane, respectively.

874 541.123.28 = 3

Solubility of hydrogen in liquid hydrocarbons. SATTLER, H. *Z. techn. Phys.*, 21, 12, *pp.* 410–413, 1940.—The solubility of hydrogen in hexane, cyclohexane, benzene, *m*-xylol at 35·2° and benzene at 72·5° was measured as function of the total gas pressure at pressures up to 150 atm. In this range the solubility is proportional to the pressure. The formula of Krichewsky and Kasarnowsky for the pressure dependence of the solubility or a similar formula derived by the author for Ostwald's solubility coefficient is satisfied by the measurements. G. H. D.

875 541.127

Further studies on the oxidation of nitric oxide; the rate of the reaction between carbon monoxide and nitrogen dioxide. BROWN, F. B., AND CRIST, R. H. *J. Chem. Phys.*, 9, *pp.* 840–846, *Dec.*, 1941.—The initial rate of the reaction between CO and NO_2 from 225° to 290°C. was measured under conditions which precluded the possibility of NO_2 decomposition. This study extends the earlier data on the reaction over a 300 deg. interval. The oxidation of NO at 25°C. and at pressures from 0·01 to 0·1 mm. of NO was found to be third-order over a 3- and 6-fold change in reactants. The CO_2 and NO_2 production in systems containing NO, CO and O_2 around 150°C., was measured under conditions in which the formation of CO_2 by the reaction between CO and NO_2 was negligible. It is concluded that NO_3 is the intermediate needed to correlate this and previous data on reactions involving NO and NO_2, and that the rate of the reaction of NO_3 with NO is faster than that with CO. A new apparatus containing greaseless valves capable of handling quantities of products of the order of 10^{-3} mm., and a method of analysis precise to 3×10^{-5} mm., was devised. Methods to prepare reactant gases of the requisite purity are described.

876 541.127

Reaction velocities at low temperatures. IV. The ionization of nitroethane at temperatures between − 32° and + 20° BELL, R. P., AND NORRIS, A. D. *J. Chem. Soc., pp.* 854–856, *Dec.*, 1941.—The kinetics of the reaction of nitroethane with NaOH in aqueous methyl alcohol have been studied at 6 temperatures between − 32° and + 20°. No deviations from the simple Arrhenius equation outside the experimental error have been observed. The rate of the reaction is smaller than that predicted by the simple collision theory by a factor of about 10^3.

877 541.127

Concentration of dilute solutions of electrolytes by base-exchange materials. BEATON, R. H., AND FURNAS, C. C. *Industr. Engng Chem.*, 33, *pp.* 1500–1513, *Dec.*, 1941.

878 541.133

The electrical conductivities of aqueous solutions of some phenanthrenesulphonic acids. BOLAM, T. R., AND HOPE, J. *J. Chem. Soc., pp.* 843–849, *Dec.*, 1941.—The conductivities and densities of aqueous solutions of *p*-toluenesulphonic acid, phenanthrene-2-sulphonic acid, phenanthrene-3-sulphonic acid, 9-chlorophenanthrene-3-sulphonic acid, and 9-bromophenanthrene-3-sulphonic acid have been determined at 18° and 25° over a wide range of concentrations. In sufficiently dilute solutions the conductivity varies

with the concentration according to the Onsager theory. Although the conductivity curve for the toluene acid is essentially that of a simple strong electrolyte, the curves for the phenanthrene acids show features characteristic of the behaviour of colloidal electrolytes. The tendency to form micelles at relatively low concentrations increases in the order 3-acid, 2-acid, chloro-acid, bromo-acid. The conductivities of isotropic solutions of the halogenated acids do not pass through min., and have practically identical values at the highest concentrations. It is confirmed that the chloro-acid shows anisotropy more readily than the bromo-acid. As a whole, the data for the halogen derivatives indicate that these compounds form 2 types of aggregate in aqueous solution. In all cases the density varies linearly with the concentration over a considerable range. No breaks were detected in the density curves for the halogenated acids.

879 541.134

Relation of electromotive force to the concentration of deuterium oxide in saturated standard cells. BRICKWEDDE, L. H., AND VINAL, G. W. *J. Res. Nat. Bur. Stand., Wash.*, 27, *pp.* 479–489, *Dec.*, 1941.—The work on characteristics of saturated Cd cells, containing small percentages of deuterium oxide (D_2O) [Abstr. 2589 (1938)], has been extended to include various concentrations up to 98 mole % D_2O. For each group of the cells, crystals of $CdSO_4$ were prepared in equilibrium with the isotopic composition of the respective saturated solutions. At 98 mole % D_2O the e.m.f. is 388 μV less than that of the control cells containing normal water. The relation between the e.m.f. of the cells and the D_2O content of the water is linear from 0 to 50%. Above 50% the e.m.f. is decreased slightly more. The changes with temperature, hysteresis effects and internal resistance of the cells, were measured. Observations on cells made 4 years ago, as well as those made more recently, justify the conclusion that cells containing D_2O are as reproducible and constant as the more usual type made with normal water. The difference between the partial molal free energy of $CdSO_4$ and H_2O in D_2O solutions is calculated.

880 541.135.5

A constant mercury level for the dropping mercury electrode. LANGER, A. *Industr. Engng Chem. (Analyt. Edit.)*, 13, *p.* 794, *Nov.* 15, 1941.

881 541.135.5 : 621.357.035.2.072.2

Studies in electrode polarization. IV. The automatic control of the potential of a working electrode. HICKLING, A. *Trans. Faraday Soc.*, 38, *pp.* 27–33, *Jan.*, 1942.—[See Abstr. 2718 (1941)]. An electrical circuit is described whereby the potential of a working electrode is automatically maintained at any desired arbitrary value. Some of the main applications of the device, which is termed a potentiostat, to electrochemical problems are given and typical examples illustrated.

882 541.138.3

Electrolytic reduction of organic compounds. IV. Bi-molecular products from sorbic acid at a solid and a liquid gallium cathode: analogy with over-voltage. WILSON, K. B., AND WILSON, C. L. *J. Chem. Soc.*, *pp.* 874–877, *Dec.*, 1941.—The reduction of sorbic acid in alkaline solution at a Ga cathode to give a mixture of dihydro-acids and bimolecular product is described. On raising the temperature a marked increase in the formation of bimolecular product occurs when the Ga melts (29°). Attention is drawn to the similarity between this behaviour and that of over-voltage. Further experiments with solid cathodes, and the effect of current density at Hg cathodes, confirm the view that bimolecular (pinacol-like) products are favoured by high over-voltage conditions.

883 541.141.1 = 3

Optical dissociation of the molecule HgICl. WIELAND, K. *Helv. Phys. Acta*, 14, 5–6, *pp.* 313–314, 1941.

884 541.145

The mercury photosensitized reactions of ethylene. LEROY, D. J., AND STEACIE, E. W. R. *J. Chem. Phys.*, 9, *pp.* 829–839, *Dec.*, 1941.—An investigation has been made of the mercury ($^3P_1$) photosensitized reactions of ethylene. In addition to hydrogen and acetylene the main products are butene, butane and hexenes. The variation of the rate with the pressure of ethylene suggests that a deactivation process is involved.

885 541.18 : 531.73

Modified electrometric determination of metallic silver by a dead-stop end-point procedure. LAMBERT, R. H., AND WALKER, R. D. *Industr. Engng Chem. (Analyt. Edit.)*, 13, *pp.* 846–848, *Nov.* 15, 1941.

886 541.18 : 537.226 = 3

Dielectric measurements on colloids. KRUYT, H. R., AND KUNST, H. *Kolloid Z.*, 91, *pp.* 1–10, *April*, 1940.—Previous measurements on hydrophile colloids [Abstr. 833 (1938)] have shown that a relation exists between hydration and polarization. The question remains whether the polarization of the double layer plays any part in the increase of dielectric const. The effect of electrolytes on hydrophile colloids, and the dielectric const. of hydrophobe sols, were investigated by measuring the capacitance of a liquid condenser in parallel with a resonance circuit at various wavelengths. A substitution method was used for the measurements. The apparatus is described and illustrated. Tables and graphs show the functional relation between dielectric const. and concentration, wavelengths and viscosity, for various colloidal substances. The results of the investigations show that polarization, as well as hydration, affects the dielectric const. R. N.

887 541.182.053

Dispersion of pigments by ball and pebble mills. FISCHER, E. K. *Industr. Engng Chem.*, 33, *pp.* 1465–1471, *Dec.*, 1941.—Optimum conditions for the operation of steel-ball mills for pigment dispersion have been investigated experimentally in mills ranging from laboratory to production sizes. Microscopic examination of the dispersions and the rate of strength development were used as criteria for evaluation. The dispersion rates were correlated with ball size, relative volume of ball and mix charges, and mill diameter. The charge ratios usually recommended depart considerably from optimum milling conditions. By adjustment of the formulation to allow proper cascading of the balls and by maintaining the charge only slightly in excess of the voids in the ball mass, milling times can be shortened. Operating in this way, laboratory mills provide a close indication of the results obtainable with production-size mills.

888 541.182.5

The phenomenon of thixotropy in hemophilic and heparinized blood. COPLEY, A. L. *Science*, 94, *pp.* 543–544, *Dec.* 5, 1941.

889 541.182.63.041

Settling and thickening of aqueous suspensions. KAMMERMEYER, K. *Industr. Engng Chem.*, 33, *pp.* 1484–1491, *Dec.*, 1941.—The behaviour of aqueous suspensions of $CaCO_3$, $BaSO_4$ and Si was studied in settling, with and without stirring. The factors influencing the ultimate settling height, or the sedimentation volume, are primarily the initial wt. conc. of the suspension and the type of settling. The relation between the ratio of H_u/H_o (ultimate and initial settling ht., respectively) and the initial wt. conc., C_o, of suspensions can be expressed by $H_u/H_o = \alpha C_o^n$, where α and n are related to particle size and compressibility, respectively. In the case of thickening, more than 1 equation may be needed; above a certain bulk conc. a decrease in packing may occur which is believed due to thixotropy.

890 541.183.5

Micromethod of chromatographic analysis. CROWE, M. O'L. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 845–846, *Nov.* 15, 1941.

891 541.24

The Signer method for determining molecular weights. CLARK, E. P. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 820–821, *Nov.* 15, 1941.

892 541.53

The equilibrium between cuprous and cupric compounds in presence of metallic copper. RANDLES, J. E. B. *J. Chem. Soc.*, *pp.* 802–811, *Dec.*, 1941.—Many cuprous salts tend to decompose into the cupric salt and copper, thus exemplifying one of the types of instability shown by particular valency states of some metals. The factors governing this instability and the equilibrium between cuprous and cupric compounds in solution in presence of copper have been investigated. The chief controlling factor appears to be the degree of covalency or electrovalency of the bonding between the copper ions and neighbouring ions or molecules, which is mainly dependent on the polarizability of the latter. Theory indicates that decreasing electrovalency and increasing covalency should favour the relative stability of the cuprous state, and experimental investigation of the equilibrium under various conditions confirms this.

See Abstr. 832 541.57 : 539.132

893 541.6

The Azo-group as a chelating group. V. Metallic derivatives of arylazo-oximes and of formazyl compounds. HUNTER, L., AND ROBERTS, C. B. *J. Chem. Soc.*, *pp.* 823–826, *Dec.*, 1941.—Cobaltic complexes of 6 arylazo-aldoximes and cupric, nickel and cobaltous complexes of 6 formazyl compounds are described. From their properties they are shown to be co-ordination compounds, the central metal atom deriving electrons from one of the azo-nitrogen atoms.

894 541.62

The associating effect of the hydrogen atom. IX. The N–H–N bond. Virtual tautomerism of the formazyl compounds. HUNTER, L., AND ROBERTS, C. B. *J. Chem. Soc.*, *pp.* 820–823, *Dec.*, 1941.—[See Abstr. 937 (1940)].—On the grounds of their physical properties and the isolation of chelate metallic derivatives [Abstr. 893 (1942)], the formazyl compounds are assigned an internally co-ordinated (hydrogen-bond) structure, which accounts for their virtual tautomerism. Three pairs of alleged isomers are shown to be, in fact, 3 single individuals; a 4th pair probably permits of similar simplification.

895 541.8 : 532.77 = 3

Relations between surface tension, inner pressure, vapour pressure and osmotic pressure. A contribution to the study of solutions. GIOCALONE, A. *Z. phys. Chem. A*, 188, *pp.* 1–10, *Jan.*, 1941.—Experimental and calculated results are given for solutions of homologous series. A law is found for the lowering of the f.p., similar to that established by Traube for capillary activity, although for very different ranges of concentration. R. N.

PRACTICAL CHEMISTRY

896 542.6

A simplified microhydrogenation apparatus. JOHNS, I. B., AND SEIFERLE, E. J. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 841–843, *Nov.* 15, 1941.

897 542.64 : 537.36

A suggestion for a new method of fractionation of proteins by electrophoresis convection. KIRKWOOD, J. G. *J. Chem. Phys.*, 9, *pp.* 878–879, *Dec.*, 1941.—In the thermal diffusion method the separation of the

components of a solution or gas mixture is effected by means of a differential horizontal transport arising from thermal diffusion, superposed upon a vertical transport arising from convection in a canal connecting upper and lower reservoirs of the fractionating unit. For the fractionation of proteins in solution, electrophoresis is proposed as the means of horizontal transport, and an apparatus is schematically described whereby, from the mathematical analysis given, significant separations should be attainable in periods of time of the order of several days, with applied fields of the order of 0·1 V/cm., electrophoretic mobility differences of the order of 10^{-3} cm.^{2}/V sec., and diffusion const. of the order of 10^{-6} cm.^{2}/sec., with the use of canals, 1 m. long and 1 mm. thick, across which temperature differences of the order of 1 deg. are maintained. H. H. HO.

898 542.67

Controlling apparatus to eliminate waste of water in using the ordinary filter pump. HOLMES F. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 759–763; *Disc.*, 763–764, *Nov.* 15, 1941.

899 542.69

A laboratory water bath for cooking, mashing, and fermentation studies. COLES, H. W., AND TOURNAY, W. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *p.* 840, *Nov.* 15, 1941.

900 542.7

A laboratory-scale flow regulator. CHELDELIN, V. H., AND CHRISTENSEN, B. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *p.* 805, *Nov.* 15, 1941.

901 542.7

Two improved pressure-regulation devices. THELIN, J. H. *Industr. Engng Chem.* (*Analyt. Edit.*), 13, *pp.* 908–910, *Dec.*, 1941.

See Abstr. 740 543.9 : 535.33

See Abstr. 757 545 : 535.414

CRYSTALLOGRAPHY

902 548 : 537.228.1

On the distribution of lattice vibrations of the KCl crystal. IONA, JR., M. *Phys. Rev.*, 60, *pp.* 822–826, *Dec.* 1, 1941.—The distribution of characteristic vibrations of the KCl crystal is calculated following Born, v. Kármán and Blackman, under the assumption of both electrostatic and repulsive forces between the ions, the latter calculated for the 18 nearest neighbours from the elastic constants and the residual-ray frequency. Application of this distribution is made to the evaluation of the sp. ht. at low temperatures.

903 548 : 537.312.8

The change in the electric resistance of a single crystal of magnetite by magnetic field at low temperatures. MASUMOTO, H., AND SHIRAKAWA, Y. *Phys. Rev.*, 60, *p.* 835, *Dec.* 1, 1941.

904 548 : 539.32

Theory of the elasticity of polycrystals with viscous grain boundaries. ZENER, C. *Phys. Rev.*, 60, *pp.* 906–908, *Dec.* 15, 1941.—The paper investigates the elastic properties of a specimen in which the grain boundaries are incapable of supporting shearing stresses. In such a specimen Young's modulus is found to be from 50% to 76% of its value when no slip at grain boundaries occurs, depending upon Poisson's ratio. This reduction of Young's modulus by slipping at grain boundaries should be observable by comparing values measured statically at elevated temperatures with those measured dynamically.

See Abstr. 869 548 : 539.434

905 548.5

Crystallization in an inflated rubber balloon. SCHALLAMACH, A. *Nature, Lond.*, 149, *p.* 112, *Jan.* 24, 1942.

906 548.7

Structure of tricalcium aluminate. MCMURDIE, H. F. *J. Res. Nat. Bur. Stand., Wash.*, 27, *pp.* 499–505, *Dec.*, 1941.—A review of the work on the structure of $Ca_3Al_2O_6$ is given. The present study shows that $Ca_3Al_2O_6$ has a cubic unit cell having $a_0 = 15{\cdot}24$ Å, and with 24 molecules present. By comparison with other compounds with similar pattern it is seen that the metal atoms are arranged at or near the centres and corners of 3·81 Å cubes. No deductions can be drawn about the oxygen arrangement from a consideration of the strong lines only. Since there are many compounds which give patterns whose strong lines are those of a body-centred cube with 3·81 Å edges, it is suggested that the pattern, obtained by Brownmiller from slowly quenched glasses of portland cement compositions, was the result of submicroscopic quench growths of metastable crystalline compounds.

907 548.73

The crystalline structure of Pt_3O_4. GALLONI, E. E., AND ROFFO, JR., A. E. *J. Chem. Phys.*, 9, *pp.* 875–877, *Dec.*, 1941.—By X-ray diffraction the chemical formula and crystal structure of Pt_3O_4 have been established. The crystal lattice has a body-centred cube symmetry. The edges of the cubes are 6·226 Å long, and there are 2 molecules per unit cell. A chemical method for preparing this oxide has been given by Jörgensen but Wöhler claims that the compound thus obtained is a mixture of monoxide and dioxide rather than a separate chemical entity.

See Abstr. 792, 793, 794, 795, 796, 797, 798, 799, 800 548.73 : 535.3 : 537.531

GEOPHYSICS

See Abstr. 933 550.3 : 538.22 : 551.2

908 550.311

Thermodynamic origin of the earth's core. I–II. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res.*

Inst., Tokyo, 18, *pp.* 359–369, *Sept.*, 1940, *and* 19, *pp.* 1–8, *March*, 1941.—To determine whether the earth's core is gaseous or liquid and whether, in the case of a liquid core, condensation occurred direct from a large primitive gaseous sphere that separated from the sun or from some special gaseous conditions, the problem of polytropic gas within the core is solved. The density distribution in the rocky shell was assumed to be uniform in one case and such as suggested by Jeffreys in another case. With the theory of nuclear transformation of elements in mind it is likely that the earth's core is gaseous with a temperature of the order 1 000°K to 10 000°K., but disregarding this theory a liquid core may be possible. For a gaseous core the conditions of density, pressure and longitudinal-wave propagation give a polytropic index of the gas $n = 0{\cdot}3$, nearly. It is concluded that initially the gaseous part not condensed was sealed near the central part of the ball and compressed externally, the temperature of the gaseous part rising with increased pressure. This, however, may be an idealized case of a gas heavily occluded by a metal.

R. S. R.

909 550.312

Viscosity distribution within the earth. I. Preliminary notes. II. The shadow zone for seismic waves. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 169–177, *June*, 1940, *and* 19, *pp.* 14–25, *March*, 1941.—Investigations on the persistence in variation in latitude and the damping of seismic waves gave a coefficient of viscosity (μ) of about 5×10^{20} c.g.s. units. A preliminary consideration of an analysis of seismic records and the theory of surface and 3-dimens. waves gave μ for the rocky shell of the earth between 10^9 and 10^{10} c.g.s. units. Two conditions of the crust were considered when investigating the origin of the shadow zone for seismic waves at an epicentral distance near 10° of arc, (1) the critical refracting angle, and (2) viscosity distribution within the earth. It appears that in the layer shallower than 70 km. $\mu < 10^{10}$ c.g.s. units, while between 70 and 100 km. μ lies between 10^{10} and 10^{11}. The change is probably due to a change from crystalline to vitreous rock. Below 100 km. μ decreases with increasing depth, becoming $= 10^5$ at 1 000–2 000 km.

R. S. R.

910 550.312

Relation between the gravity anomalies and the corresponding subterranean mass distribution. V. TSUBOI, C. **Relation between the gravity anomalies and the corresponding subterranean mass distribution. VI.** TSUBOI, C., AND YAMAGUTI, S. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 384–400, *Sept.*, 1940, *and* 19, *pp.* 26–28, *March*, 1941.—The double Fourier series method [Abstr. 3957 (1939)] is used in computing the geographical distribution of the isostatic anomalies in the U.S.A. and next, with that as basis, the undulation of the isostatic geoid.

911 550.34 = 956

The earthquake-proof building on the site of the Hikone Castle. SAITA, T. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 692–697, *Dec.*, 1940.

912 550.34 = 956

The earthquake-proof buildings in the Kyoto Imperial Palace. SAITA, T. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 698–700, *Dec.*, 1940.

913 550.34

Mechanism of faulting in S. California indicated by seismograms. GUTENBERG, B. *Bull. Seism. Soc. Amer.*, 31, *pp.* 263–302, *Oct.*, 1941.—Seismograms relating to all local earthquakes over a period of 7 years for Central and S. California were investigated to obtain the distribution and patterns of compression and dilatation. These patterns formed by areas with initial dilatations strongly support the elastic-rebound theory of the faulting process given by Reid. South of the Transverse Ranges the directions of the movements, with few exceptions, are very uniform from the continental shelf to beyond the Andreas fault, where the shocks become scarce and supply seismograms showing only small beginnings. In almost all earthquakes the block on the N.E. side of the fault moves S.E. relative to the shock. Vertical movements are usually relatively small. Northward from the Santa Monica Mts. the fault pattern complicates the picture, but the general results are similar. In the Sierra Nevada other types of movement are of greater importance. Southern and Central California from the oceanic margin of the shelf to beyond the regions of Owens Valley and Imperial Valley are under a shearing stress directed approx. towards the S.E. at the bottom of the continent relative to the crust beneath the Pacific. The source of the stress is unknown but it is probably connected with the difference in structure of the earth's crust under the Pacific Basin and under the continent. R. S. R.

914 550.34 : 621.396.91

The cut-off bias principle in automatic time recording. SULKOWSKI, E. L. *Bull. Seism. Soc. Amer.*, 31, *pp.* 345–347, *Oct.*, 1941. [Abstr. 593 B (1942)].

915 550.341

The unusually large microseisms of Oct. 21, 1938, at Hongo, Tokyo. KISHINOUYE, F. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 401–418, *Sept.*, 1940.

916 550.341

The great Chilean earthquake of January 24, 1939. SAITA, T. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 446–459, *Sept.*, 1940.

917 550.341

A supplement to Lee's paper—A world-wide survey of microseismic disturbances recorded during January 1930. KISHINOUYE, F. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 507–513, *Dec.*, 1940.—[See Abstr 207 (1935)].

918 550.341 = 4

On the characteristics of seismic waves from observations obtained by large seismographs of accelerometer type. IIDA, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 532–573, *Dec.*, 1940.—An analysis of 318 registrations spread over 13 months to discover the nature of waves due to terrestrial vibrations was made for both horizontal and vertical components. It was found that (1) small shocks appear to have a character similar to large ones; (2) the max. acceleration of small shocks does not exceed 0·4 gal.; (3) a very large number of terrestrial vibrations were observed with a small acceleration, and for the number of shocks (N) and the max. acceleration (A) for horizontal and vertical components the relation $NA^m = K$ holds; (4) for small shocks the predominant periods are relatively short, not exceeding 0·2 sec., and mostly about 0·1 sec., increasing as distance and intensity increase, a close relation exists between small seismic shocks and the thickness of various layers in the superficial crust; (5) the frequency and the acceleration amplitude are related by $N = N_0 e^{-qA}$. R. S. R.

919 550.341 = 956

Observations on earthquakes recorded by the microseismograph. IIDA, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 575–674, *Dec.*, 1940.

920 550.341 = 956

Tunami associated with the earthquake of August 2, 1940. MIYABE, N. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 104–114, *March*, 1941.

921 550.341 = 956

Earthquake vibrations on quays and on reclaimed ground in the harbour of Yokohama. SAITA, T., AND MATUO, H. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 216–217, *June*, 1941.

922 550.341

Trial travel times for N.E. America. LEET, L. D. *Bull. Seism. Soc. Amer.*, 31, *pp.* 325–334, *Oct.*, 1941.—A series of type records and travel-time data have been assembled. Results were obtained from Benioff seismographs at NESA stations and are preliminary, but the structure they represent is summarized for reference in a table. This table is in marked disagreement with tables of Jeffreys for surface focus and small distances, and probable causes of the differences are discussed. R. S. R.

See Abstr. 721 550.341 : 517.433 : 534.213

See Abstr. 727 550.341 : 517.433 : 534.811

923 550.341 : 534.213

Dynamical absorption of the energy of Rayleigh waves and Love waves by weak surface layers. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 345–358, *Sept.*, 1940.—It is shown mathematically that a weak or dense surface layer serves as a dynamic damper to Rayleigh or Love waves transmitted along that layer. The attenuation coefficient of any surface waves, in the case of the surface layer being viscous, is much greater than that in the case of the subjacent layer being viscous. Thus, with increase in epicentral distance, seismic surface waves transmitted through a region covered with fairly thick loam would be damped to a certain extent, but these waves when transmitted through a rocky surface would scarcely be damped even should the amplitude of the waves on the surface be small. Consequently the best way to avoid seismic disturbances due to machinery working on surface traffic is to cover the ground for a certain area round the source with a loose soil layer of a certain thickness. R. S. R.

924 550.341 : 534.213

Action of soil layers and of the ocean as dynamic dampers to seismic surface waves and notes on previous papers. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 150–168, *June*, 1940.—In the mathematical investigation the existence of vibrators of relatively simple type is assumed instead of considering the actual medium in the soil layer. It was found that a surface soil layer serves as a dynamic damper to seismic surface waves, provided that the layer is fairly thick, of low elasticity and viscous. The attenuation coefficient of the boundary waves in the soil layer with a given viscosity, and which rests on a semi-infinite subjacent elastic medium without viscosity, is much greater than the coefficient of Rayleigh waves transmitted through a semi-infinite body with the same elasticity as the soil layer. Although the coeff. of the waves in the case of the surface layer and the subjacent medium, both being viscous, is naturally greater than with only the surface layer viscous, the increment of the coeff. is not very marked. It is shown that the sea scarcely contributes to the damping of the waves, a fact indicated by the small viscosity of water compared with solid matter. A modification of the results obtained for the damping of periodic visco-elastic waves with increase in focal distance is given [Abstr. 2464 (1939)]. A further note extends the results obtained for Love waves in heterogeneous media. R. S. R.

925 550.341 : 534.25

A fault surface or a block absorbs seismic wave energy. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 465–482, *Dec.*, 1940—The effect of the discontinuity on elastic waves is investigated mathematically, and among the conclusions arrived at are the following: If a discontinuous surface in the earth's crust has a frictional resistance of dissipative nature, the input energy of the waves is partly absorbed by the surface. The absorption becomes a max. for a medium value of the coeff. of

friction. If the coeff. is infinitely great, all the input energy is liberated. If discontinuous surfaces form a crustal block, the liberated energy and vibration amplitude of the block cannot greatly exceed those of the incident waves. The general effect of wavelength on absorption is not very marked. G. E. A.

926 550.341.2 = 3

Earthquake frequency in relation to the position of the sun and moon. MATUZAWA, T., HAYAKAWA, M., HATTORI, Y., KANEKO, T., AND MIYAMURA, S. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 265–280, *June*, 1940.—Earthquake frequency has a regional characteristic. In the Japanese–Philippines zone there is probably an annual periodicity with a max. in summer. On the west coastal zone of S. America there is a ½-yearly periodicity with max. in summer and winter; probably also a synodic ½-monthly periodicity. The yearly oscillation depends mainly on the meteorological action of the sun and the monthly oscillation mainly on tidal action. R. S. R.

927 550.341.2 = 3

On the empirical formula, $na^m = k$, of Ishimoto and Iida between earthquake frequency, n, and amplitude, a. MATUZAWA, T. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 411–415, *June*, 1941.—Ishimoto and Iida obtained their formula by consideration of earthquake observations for a special period of time at a particular station. An expression is obtained for the frequency distribution for a region between radii r_1 and r_2 from the station. It is concluded that the distribution function can be determined exactly only by considering earthquakes from a limited part of the earth. R. S. R.

928 550.361

Effect of distribution of heat-generating sources on the temperature gradient in the earth's crust. SEZAWA, K., AND KANAI, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 137–149, *June*, 1940.—Mathematical investigations were made for uniform, sinusoidal and rectangular areal distribution of heat sources in the surface layers and for concentrated sources at antisymmetrical periodic points. It is found that the greater the ratio of the conductivity in the lower layer to that in the upper layer, the more does the gradient under consideration diminish. This diminution becomes insensible if the intensities of sources fluctuate and the wavelength of the fluctuation is $<\frac{1}{2}$ the thickness of the layer of the sources. It is concluded that, although the temperature gradient on the surface of the earth's crust is nearly const. for any place, the intensity of the heat generated in the crust at that place could differ greatly from that in any other place. The effect of local heat sources at depths of 10 to 20 km. on the gradient is $<10\%$ of that for uniform sources extending to infinity. These results hold only for the crust. The effect of conductivity in the lower layer is considered. R. S. R.

929 550.361

Geothermal gradient at Grass Valley, Calif.: A revision with a note on the flow of heat. SPICER, H. C. *J. Wash. Acad. Sci.*, 31, *pp.* 495–501, *Dec.* 15, 1941.

See Abstr. 934 550.38 : 551.21

930 550.381

A statistical analysis of the earth's internal magnetic field. ELSASSER, W. M. *Phys. Rev.*, 60, *pp.* 876–883, *Dec.* 15, 1941.—The earth's internal magnetic field consists of the field of a large dipole and an irregular part which is of the order of a few percent of the main dipole field. The field may be represented by a series of spherical harmonics and 42 coefficients are numerically known. The coefficients which characterize the irregular part of the field are here statistically compared with a simple model for this field. It is assumed that an arbitrary number of dipoles are thrown at random inside a spherical shell and mean values are calculated for the probabilities with which the various spherical harmonics appear in the field produced. It is shown that a statistical agreement between the observed and calculated coefficients can be obtained only if the outer radius of the spherical shell is approx. 0·50 R and is definitely not in excess of the radius of the earth's core, 0·55 R.

931 550.382

On the natural remanent magnetization of the lava composing the central cone of Volcano Mihara. NAGATA, T. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 281–287, *June*, 1940.—The direction and intensity of the residual magnetization in 11 samples of lava ejected from the volcano are measured with an astatic magnetometer. It is concluded that the magnetization found is the result of the cooling of the lava, through the Curie point of the ferromagnetic minerals contained in the rock, in the presence of the earth's magnetic field. A. HU.

See Abstr. 959, 960 550.385 : 551.594.5

932 550.386

Changes in the vertical intensity of geomagnetism that accompanied the eruption of Miyakezima in 1940. TAKAHASI, R., AND HIRANO, K. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 82–103, *March*, 1941.

See Abstr. 728 550.834 : 534.811

933 551.2 : 550.3 : 538.22

The eruption of Miyake-sima, one of the seven Izu Islands, in 1940. I. Geological observations of the Miyake-sima eruption of 1940. (I). TSUYA, H. **II. The temperature of lava.** NAGATA, T. **III. Viscosity of the Akabakkyô lava.** HAGIWARA, T. **IV. The magnetic properties of the new ejecta.** NAGATA, T. **V. The earthquakes that accompanied the eruption.** HAGIWARA, T. **VI. Pulsations of the ground that accompanied the volcanic activity.** MINAKAMI, T. **VII. Anomalous change in geomagnetism accompanying the volcanic activity.** NAGATA, T. **VIII. A mag-**

netic dip survey of Miyake-sima. MINAKAMI, T. **IX. Time variations in magnetic dip, and their topographical distribution in Miyake-sima.** MINAKAMI, T. **X. Changes in earth potential after the eruption.** HAGIWARA, T. **XI. Changes in the vertical intensity of geomagnetism that accompanied the eruption.** TAKAHASI, R., AND HIRANO, K. **XII. A topographic survey of the new parasitic cones and the new lava flow of Miyake-sima.** OMOTE, S. **XIII. Horizontal and vertical ground displacements associated with the eruption.** OMOTE, S. **XIV. A graph for comparing changes in the amplitude of daily pulsations, the number of daily earthquakes, the earth potential, and the magnetic dip.** HAGIWARA, T., MINAKAMI, T., AND NAGATA, T. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 260–401, *June*, 1941.

934 551.21 : 550.38

A geomagnetic study of the minor activities of Volcano Mihara, Oosima Island, August 1940. NAGATA, T. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 402–410, *June*, 1941

935 551.243

Observation of changes in the inclination of the earth's surface at Mt. Tukuba (Second report). HAGIWARA, T. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 218–227, *June*, 1941.

936 551.244

Studies in the sinking of the earth's surface in Tokyo. V. MIYABE, N. *Bull. Earthq. Res. Inst., Tokyo*, 18, *pp.* 505–506, *Dec.* 4, 1940.

937 551.244

Upwarp deformation of the land in Tyūgoku. MIYABE, N. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 228–237, *June*, 1941.

938 551.244 = 956

Results of re-levelling in Tokyo, in 1940. MIYABE, N., AND HUKUNISI, S. *Bull. Earthq. Res. Inst., Tokyo*, 19, *pp.* 248–259, *June*, 1941.—In March–April 1938 a line of levels was run in Tokyo, involving about 400 bench-marks. This line was re-run in March–April 1940, and the vertical displacements of the bench-marks were deduced by comparing the results of the 2 levellings. The vertical displacements thus deduced are referred to the standard datum point, the height of which remained unchanged during the period. A line of levels, involving 20 bench-marks, distributed in the neighbourhood of Hibiya, where the rapidity of the sinking of the earth's surface is rather marked, were re-levelled 7 times since May 1938. Analysis of the data suggested that the vertical displacements measured as having occurred during the intervening months consist of 2 components, the sinking due to the shrinkage of the soft soil composing the overlying layer and the displacement resulting from tilting of the underlying layer of hard rocks. Since the latter is quasi-periodic and the former is monotonically progressive, the vertical displacements measured for the shorter period of time are fluctuating, while those for the longer period of time are steady, being approx. the same.

939 551.506.2

Agricultural meteorology: summer sequence of monthly mean temperature at Winnipeg, Swift Current and Edmonton. HOPKINS, J. W. *Canad. J. Res. C*, 19, *pp.* 485–492, *Dec.*, 1941.—An analysis of the monthly sequence of mean temperature during the summer period April–Sept. 1894–1937 has been made by expressing each annual sequence as an orthogonal polynomial function of time. Whereas the precipitation sequence, previously studied, required terms of the 4th or 5th degree for its adequate representation, the average temperature sequence at all 3 stations was very closely approximated by a 3rd degree polynomial. On the average, corresponding coeff. for each station differ significantly, indicating decreasing continentality of the temperature régime with distance westward from Winnipeg. Annual variations in corresponding coeff. for the 3 locations are appreciably correlated, but for the most part exhibit no regular sequence in time. However, in recent years at Edmonton the mean temperature for April has tended to be lower, and that for July and Aug. to be slightly higher, than previously. There is some suggestion of a feeble inverse correlation in the annual fluctuations of temperature and precipitation.

940 551.509.3

Report of the 5-day forecasting procedure, verification and research as conducted between July, 1940, and August, 1941. WILLETT, H. C., ALLEN, R. A., AND NAMIAS, J. *Pap. Phys. Oceanogr. Met., Massachusetts*, 9, [88 *pp.*], *Nov.*, 1941.—Rossby's conception of the general circulation of the atmosphere is outlined and used as the basis for the forecasting technique, and a study of the statistical or mean circulation is extrapolated into the future. The statistical side includes the preparation of the surface and 3 km. indices of the zonal westerlies and the surface zonal easterly index. The prognostic surface and 3 km. pressure charts and the isentropic chart are then prepared. Based on these the prognostic temperature and precipitation charts are constructed with the help of statistical probability of occurrence of each class of anomaly in any given region. With these account is taken of local peculiarities of sea temperature, topography, and the character of the previous 5 days. The general forecast is formulated for the whole of U.S.A. divided into 11 districts with a daily sequence of events as far as possible. The procedure is illustrated by an example. Verification of each forecast is carried out numerically and by charts. Reports are given of 8 special investigations to supplement certain parts of the 5-day procedure but the results are not conclusive. R. S. R.

See Abstr. 951 551.509.3 : 551.593.54

941 551.509.33

Long-range forecasts of rainfall in India. BASU, S. *Sci. & Cult.*, 7, *p.* 269, *Nov.*, 1941.

942 551.509.33 : 551.578.1

Forecasting monsoon rainfall in Mysore. IYER, V. D., AND SESHACHAR, C. *Sci. Notes India Met. Dep.*, 8, 95, *pp.* 117–129, 1941.—The State is divided into the 2 natural regions, Malnad and Maidan, and sets of correlation coefficients are worked out for each of these regions. Formulae for forecasting the monsoon rainfall of June to Sept. are derived for both the regions. For the Maidan region a formula for forecasting the rainfall of Sept.–Nov. is also obtained

943 551.521.1

Solar radiation and sunspot data for August, 1941. CULLINANE, H. *Mon. Weath. Rev., Wash.*, 69, *pp.* 252–256, *Aug.*, 1941.

944 551.521.2

Observations of atmospheric radiation. BROOKS, F. A. *Pap. Phys. Oceanogr. Met., Massachusetts*, 8, [23 *pp.*], *Oct.*, 1941.—Observations were made, with the parallel-beam radiometer, of atmospheric radiation and of the night sky to determine emissivity and absorptivity. The relation between the 2 sets of measurements was obtained by simultaneous radiosonde measurements of moisture and temperature conditions aloft. A curve is obtained for the transmissivity of the atmosphere for path lengths of 0·001 to 200 mm. precipitable water in terms of black-body radiation. This curve can be applied to outdoor heat transfer, such as the nocturnal rate of cooling of leaves on the side of trees, if the moisture and temperature distributions in the air overhead are known. The parallel-beam radiation values can be converted to hemispherical radiation for a horizontal surface. Fair estimates of the winter whole-sky radiation can be made. R. S. R.

945 551.524.32

A new type of temperature graph for the geographer. DEASY, G. F. *Mon. Weath. Rev., Wash.*, 69, *pp.* 229–234, *Aug.*, 1941.

946 551.577.3

Absolute and relative variability of rainfall. BONACINA, L. C. W. *Quart. J. Roy. Met. Soc.*, 67, *pp.* 313–314, *Oct.*, 1941.

See Abstr. 942 551.578.1 : 551.509.33

947 551.582

Meteorological and climatological data for August, 1941. DYCK, H. D. *Mon. Weath. Rev., Wash.*, 69, *pp.* 235–252, *Aug.*, 1941.

See Abstr. 655 551.582.2 : 551.506.3

948 551.582.3

Climatological Data. *Climatol. Data W. Indies*, 21, *pp.* 1–8, *Jan.*; 9–16, *Feb., and pp.* 17–24, *March*, 1941.

949 551.583.14

Climatic indicators. CALLENDAR, G. S. *Quart. J. Roy. Met. Soc.*, 67, *pp.* 385–386, *Oct.*, 1941.

950 551.593

The polarization of atmospheric haze. NEUBERGER, H. *Science*, 94, *pp.* 485–486, *Nov.* 21, 1941.

951 551.593.54 : 551.509.3 = 3

On the importance of haze strata in forecasting. LÖHLE, F. *Met. Z.*, 57, *pp.* 73–79, *Feb.*, 1940.—An analysis is made of observations taken in April 1939 during a flight between Berlin and Cologne, in heights between 1 200 and 2 000 m., which led from an anticyclonic ridge to a region of disturbance caused by an upper cold front. The changes in shape and colour of the layers of haze, the varying visibility, and the wind and cloud formations, were observed and compared with the data of the weather map. [See Abstr. 2562 (1941)]. R. N.

952 551.593.653 = 3

The limits of the layer of the fluorescence radiation of sodium observed in the night sky. CARIO, G., AND STILLE, U. *Z. Phys.*, 116, 1–2, *pp.* 122–136, 1940.—The height of 60 km. derived by Bernard for the radiation of the Na layers observed during dawn and twilight represents only a min. value for the upper limit of the layer for the case of optical resonance radiation. Bernard based his computations on the assumption of a completely transparent troposphere. The troposphere, however, is actually rather opaque for sunlight at grazing incidence. Taking into account this effect of the troposphere, the authors compute the upper layer of the luminous Na layer to about 78 km. and the lower limit to about 69 km. No sodium is expected above the upper layer because of the temperature inversion of the atmosphere. The luminous clouds of the night sky are observed at the same altitude. The lower limit of the luminous layer is probably given by the extinction of resonance radiation and the formation of Na molecules. It seems feasible to measure the height of the Na layer in the upper atmosphere with considerably higher accuracy when applying a more sensitive apparatus to the investigation of the twilight. This investigation is planned. O. O.

953 551.593.9

A green moon on September 29, 1941. BONACINA, L. C. W. *Quart. J. Roy. Met. Soc.*, 67, *p.* 362, *Oct.*, 1941.

See Abstr. 671 551.594.2 : 551.551

954 551.594.2 : 621.315.015.34

Lightning phenomena. WAGNER, C. F., AND MCCANN, G. D. *Elect. Engng, N.Y.*, 60, *pp.* 374–384, *Aug.*; 438–443, *Sept., and pp.* 483–500, *Oct.*, 1941.—[Abstr. 269 B (1942)].

955 551.594.2 : 621.317.31

The direct measurement of lightning current.

FLOWERS, J. W. *J. Franklin Inst.*, 232, *pp.* 425–450, *Nov.*, 1941.—[Abstr. 405 B (1942)].

956 551.594.21

Distribution of electricity in thunderclouds. ROBINSON, G. D. *Quart. J. Roy. Met. Soc.*, 67, *pp.* 332–340; *Disc.*, 350–361, *Oct.*, 1941.—The sounding-balloon experiments carried out at Kew in the years 1934–39 are described. A simple pole-finding device records the direction of the current flowing in a vertical conductor, which is carried on the balloon together with an aneroid. Of 98 flights, 58 produced legible records, which are used as the basis for constructing a typical model thundercloud. This latter comprises a small positive charge centred at a height of 1·5 km., a main negative charge at 3·0 km. and an upper positive charge at 6·0 km. When the directions of flight of the various balloons are taken into consideration, the individual records are shown to be consistent with this model, and with this model alone; and the ground records provide corroboration. Deductions are also made concerning the charge-separating mechanism operating in thunderclouds. It is stated that a study of the polarity distribution of flashes to earth supports a simple bipolar model rather than the model with 3 centres of charge. A. HU.

957 551.594.221

Physics of lightning. ALLIBONE, T. E. *Quart. J. Roy. Met. Soc.*, 67, *pp.* 327–332; *Disc.*, 350–361, *Oct.*, 1941.—The author reviews the evidence, obtained from photographs of lightning flashes with a moving camera; from oscillograph records of lightning currents flowing to earth through towers and tall buildings; and from measurements of field intensity in the neighbourhood of thunderclouds. A tentative physical mechanism is proposed to explain the propagation of the various strokes of a lightning flash. A mechanism for the initiation of the discharge at the surfaces of individual raindrops was suggested. A. HU.

958 551.594.221

The lightning discharge. BRUCE, C. E. R., AND GOLDE, R. H. *Rep. Brit. Elect. and Allied Industr. Res. Assoc., Ref. S/T18a. J. Instn Elect. Engrs*, 88, *Part II, pp.* 487–505; *Disc.*, 505–520, *Dec.*, 1941.—A survey of the data available indicates that lightning flashes in all thunderstorms have similar characteristics as regards the times involved and the number of strokes in a flash, and it is shown that Norinder's divergent values are due to misinterpretation of his data. It is suggested that, while the charge neutralized in a lightning flash is probably about 50% greater than has hitherto been believed, the cloud potential is only a few per cent of the accepted value and the energy of a flash about 250 kWh, as compared with Wilson's value of about 2 800 kWh. A theory is advanced bearing on the mechanism of the leader and return strokes, which enables the shape of the lightning current wave to be calculated; in addition, a form is derived for the whole current wave in a multiple flash. A synthesis made from the results of many investigations leads to a picture of the mechanism of the return stroke and to the calculation of the various field changes produced, which agree well with those observed, both in shape and in amplitude. New light is thrown on the analysis of the electrostatic field change caused by a stroke. The importance of space charge is emphasized in several connections, including the neutralization of cloud charge, the frequency of "air discharges" and the peculiarity of flashes to the Empire State Building, the currents to which have been re-analysed. The effect of direct strokes to transmission lines is investigated, and it is shown that successive strokes which do not cause flashover are unlikely. The polarity of flashes to earth is shown to differ in tropical and temperate regions, and it is concluded that the polarity of strokes to phase wires cannot be deduced from that of strokes to towers.

959 551.594.5 : 550.385

Auroral display and geomagnetic storm of September 18–19, 1941. MCNISH, A. G. *Science*, 94, *pp.* 413–414, *Oct.* 31, 1941.

960 551.594.5 : 550.385

Auroral display and geomagnetic storm of September 18–19, 1941. MCNISH, A. G. *J. Roy. Astr. Soc. Can.*, 35, *pp.* 368–370, *Nov.*, 1941.—[See Abstr. 959 (1942)].

961 551.594.6 : 621.396.821

The effect of sunset on atmospherics. RAO, N. S. S. *Proc. Indian Acad. Sci. A*, 14, *pp.* 196–220, *Aug.*, 1941.—[Abstr. 194 B (1942)].

962 551.594.6 : 621.396.821

Lightning and atmospherics. LUTKIN, F. E. *Quart. J. Roy. Met. Soc.*, 67, *pp.* 345–349; *Disc.*, 350–361, *Oct.*, 1941.—The author describes the wave-form recorder and the analysis of atmospherics made possible by its use. The various forms of atmospheric are correlated with the known forms of lightning discharge, and it is concluded that all atmospherics originate in lightning flashes. Range may be roughly estimated by noting the separation in time of the 2 components, by the multiple reflection method where this is possible, and by using the amplitude of the disturbance. The cathode-ray direction finder and the narrow sector frame recorder are described and their application to meteorology discussed. An atmospherics recorder used on the Grid System for warning the control engineers of the approach of thunderstorms is described. A. HU.

See Abstr. 584 77 : 541.147

See Abstr. 736 77.011 : 535.245